Safety and Airspace Regulation Group

Report of the CAA's Post Implementation Review of the London Airspace Management Programme (LAMP) Phase 1A Module C Airspace Change Proposal – London City Network Changes

CAP 1692 C

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This report is part of a series of PIR reports for LAMP Phase 1A Airspace change proposal implemented on 4 February 2016.

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Executive Summary

1. The CAA's airspace change process is a seven-stage mechanism that is set out in detail in CAP 725. Under this process in February 2015, NATS submitted an Airspace Change Proposal (ACP) titled the London Airspace Management Programme (LAMP) Phase 1A proposal to the Civil Aviation Authority (CAA), to propose changes to airspace in the south-east of England including proposals to change a number of arrival and departure procedures at a number of aerodromes. LAMP Phase 1A was a major airspace change designed to deliver modifications to airspace arrangements affecting a broad swathe of south-east England from Stansted to the Isle of Wight in order to provide, primarily, capacity and efficiency benefits. There are five individual elements (referred to as Modules) of the LAMP Phase 1A proposal.

2. Module C was sponsored by NATS and proposed a number of changes at London City Airport (LCA) and some procedures for adjacent airports as detailed below:

- New Standard Arrival Routes (STARs) for LCA together with new Point Merge arrival 'transition' procedures.
- Revised routeing for LCA southerly SIDs (now RNAV-1[1]).
- New RNAV-5 STARs for Southend.
- Lowering of some Controlled Airspace (CAS) in the Thames Estuary to support the new procedures.
- Re-routeing of Stansted, Cambridge, Luton and Northolt 'Detling' departures towards Clacton before turning to the south-east.
- New ATS routes within existing CAS.
- RNAV-1 replications of the low altitude portions of the existing ten LCA conventional Standard Instrument Departure (SIDs) with RNAV-1 SID replications, and introduction of RNAV-1 replication arrival procedures of the LCA radar vectored arrival flight paths to intercept the Instrument Approach Procedures (IAP) for both Runway (Rwy) 09 and Rwy 27 with RNAV-1 arrival procedures; these procedures are covered in Module B.

[1] RNAV-1 denotes a performance-based navigation (PBN) standard of area navigation for use in the design of instrument flight procedures for departures and arrivals

- A portion of the Runway 09 arrival 'transition' procedure will also be used by traffic inbound to Biggin Hill.
- New Gatwick RNAV-5 STARs routeing inbound to TIMBA from the north-east/east.
- Re-sectorisation of NATS control sectors in the south and south-east

3. Stage 7 of this process is a Post Implementation Review (PIR) that normally begins one year after implementation of the change.

4. The sponsor provided PIR data to the CAA in June 2017; on 18 October 2017, the CAA commenced the PIR of the impact of its decision and the implemented change. The content and outcome of this review process by the CAA is discussed in detail in this report including its annexes.

5. On 2 January 2018, the CAA introduced a new process for making a decision whether or not to approve proposals to change airspace design (CAP1616). However, as this ACP was fully implemented prior to the introduction of that document, and the PIR data received by the CAA prior to its introduction, this review has been undertaken in accordance with CAP725 and the Department for Transport's Guidance to the Civil Aviation Authority on Environmental Objectives Relating to the Exercise of its Air Navigation Functions (2014).

6. During the review process, the CAA considered data provided by NATS. As a result, the CAA has reached the following conclusions:

Operational Conclusion

7. The implementation of the point merge procedure has been successful. ATC workload has been reduced and the new systemised airspace design has resulted in an improvement in safety risk within the Swanwick TC environment and, with the TC Thames sector. The other elements of the Module C designs have been integrated successfully with the London City point merge and new departure procedures via EKNIV. The aims and objectives of the proposal have been achieved.

Complaints Conclusion

8. For the most part, complainant locations are consistent with the traffic patterns we were expecting to see. However, there is one location where that is not the

case, which suggests that the actual traffic pattern is not as consistent with what we were expecting to see in that location.

Environmental Conclusion

9. The noise impacts are consistent with the impact anticipated in the airspace change proposal. On that basis, we consider that there has been no increase in the number of people significantly affected by noise as a direct result of the airspace change.

10. As anticipated, there has been a net reduction in the number of people overflown, whilst there is also a proportion of the population that is being overflown more often. We also identified one situation where the traffic pattern deviates from what was forecast in the consultation feedback report.

11. This Module, in conjunction with Module B, has not achieved the reduction in annual CO_2 emissions that was expected. Instead these two Modules have resulted in an increase in CO_2 emissions.

Confirmation of LAMP 1A Module C Implementation

12. In respect of Module C of LAMP Phase 1A, the CAA confirms that no modification of the RNAV-1 arrival and departure designs are required by NATS except for:

    1) Chart naming and associated data base coding changes as discussed at paragraphs 63-65. This is a requirement for the CAA to implement the ICAO arrival chart naming convention for London City and Biggin Hill arrival procedures. This is to be discussed between the SARG IFP regulators and NATS with the action ratified to implement this requirement.
    Note: this is an operational procedure naming issue and will not affect the position of any of the aircraft tracks over the ground.

    In respect of the one situation where the traffic pattern deviates from what was forecast in the consultation feedback report, we recommend that the sponsor examine why there is a traffic pattern over the Hoo Peninsular which was not portrayed in the consultation feedback report. This concludes the CAA's

airspace change process in respect of London City Airport's airspace change request dated 16 February 2015.

Note: With respect to the variance from the forecast CO_2 emission benefits and the actual CO_2 benefits realised, we recommend the sponsor investigate why the change proposal has not achieved the forecast fuel and CO_2 benefits.

The PIR Report

13. This report, and its annexes and attachments, provide a summary of the information the CAA has reviewed and taken into account before reaching these conclusions. However, all the information the CAA has taken into account is published on our website/interim portal.

Scope and Background of the PIR

What is a Post Implementation Review

14. The CAA's approach to decision-making in relation to proposals to approve changes to airspace is explained in its Guidance on the Application of the Airspace Change Process, CAP 725. This detailed Guidance provides that the seventh and last stage of the process is a review of the implementation of the decision, particularly from an operational perspective, known as a Post Implementation Review (PIR).

15. The Guidance states that the purpose of a PIR is to determine whether the anticipated impacts and benefits in the original proposal and published decision are as expected, and where there are differences, what steps (if any) are required to be taken.

16. If the impacts are not as predicted, the CAA will require the change sponsor to investigate why, and consider possible mitigations or modifications for impacts that vary from those which were anticipated to meet the terms of the original decision.

17. A PIR is therefore focused on the effects of a particular airspace change proposal. It is not a review of the decision on the airspace change proposal, and neither is it a re-run of the original decision process.

Background to our conclusions in this PIR Decision

18. On 13 October 2015, the CAA approved LAMP Phase 1A change proposals to change traffic patterns for Stansted and Luton SIDs, London City arrival and departure routes, route network changes for London City, Gatwick, Farnborough, Southampton and Bournemouth; these changes involved a variety of changes which included RNAV-1 procedures for London City arrivals and departures and a number of new ATS routes providing connectivity to the route network in adjacent States' airspace. The changes for the London City network changes were proposed as Module C which is the subject of this report. In our Decision document dated 22 December 2015, we provided information and background to the change. We recommend readers of this report read that decision in conjunction with this document.

Conditions attached to the CAA's decision to approve the change.

19. The following conditions were placed on the sponsor:

1	The GEGMU and GODLU RNAV-5 STARs do not have the required protection in accordance with the SARG AR Airspace Containment policy (i.e. 5NM either side of the nominal track) as they pass close to the north-west and north-east corners of Danger Area D037. NATS are to ensure controllers monitor traffic to ensure aircraft do not enter D037.
2	NATS to ensure traffic entering the GODLU Hold does not cross into the Paris FIR (this is a technical issue and in reality is not expected to occur).
3	NATS to ensure traffic entering the ROPMU Hold does not leave CAS to the north (this is a technical issue and in reality is not expected to occur).
4	NATS to ensure traffic entering the ATPEV Hold does not enter the Danger Areas to the north-east.
5	NATS to ensure traffic entering the OKVAP Hold does not cross into the Paris FIR (this is a technical issue and in reality is not expected to occur).
6	NATS is to monitor the performance of arrivals between: JACKO-NONVA and NONVA-BABKU, ERKEX-OKVAP, NEVIL-OSPOL and provide feedback to SARG IFP if there is evidence of any operational issues.
7	The utilisation of controlled airspace regarding climb and descent profiles following LAMP Phase 1A implementation is to be reviewed by NATS by 31 August 2016 in order to address the CAA's list of possible options for raising the lower limits of controlled airspace following implementation of LAMP Phase 1A which were discussed with NATS on 21 May 2015. NATS is to advise the CAA by 31 August 2016 regarding what revisions to the lower limits of controlled airspace are feasible and, if appropriate, advise the CAA which options are not feasible. If changes are possible, these will be co-ordinated by the CAA for implementation at the next available ICAO Southern England and Wales 1:500,000 chart update.

8	By 31 August 2016, in conjunction with the above, determine whether the lower limits of the LTMA may be raised in LTMA Sectors 3 and 8 as follows: -- LTMA Sector 3 (3500-FL195) situated south of the Southend CTA 7 and, -- the revised LTMA Sector 8 from the north coast of Kent to the boundary of the LTMA Sector 21/N859 eastern extremity taking due consideration of the new southern arrival segment of the London City arrival transition procedure. NATS is to advise the CAA by 31 August 2016 regarding what revisions to the lower limits of controlled airspace are feasible and if appropriate, advise the CAA which options are not feasible. If changes are possible, these will be co-ordinated by the CAA for implementation at the next available ICAO Southern England and Wales 1:500,000 chart update. Note: This is in conjunction with Module E.

Conditions 1-6 outcome

20. In the PIR data provided, there were no incidents reported as Mandatory Occurrence Reports (MOR) relating to reporting requirements regarding conditions 1-6. Therefore, we are satisfied that these conditions for monitoring the relevant flight paths have been met.

Conditions 7 & 8 compliance

21. For a number of reasons, a delay in completing the required review action required by NATS by 30 June 2016 was necessary and a revised deadline of 31 August was agreed with the CAA. The results of this review were subsequently provided to the CAA on 31 August 2016 and is referred to in Annex A. This will now be reviewed in light of further airspace change developments.

Condition 7 outcome

22. Regarding Condition 2, NATS complied with this condition and completed a review of the lower limits and usage by GAT in a number of areas of controlled airspace along the south coast region both over the sea and overland. A number of possibilities for controlled airspace lower limit revision were identified and discussed with the CAA including raising some lower limits of controlled

airspace mainly over the sea and more towards the Thames Estuary (in conjunction with Module C approval conditions). Adjustments and some rationalisation of controlled airspace lower limits was circulated to NATMAC members prior to NATMAC 80 in October 2017. Some NATMAC members responded, however, when discussed at NATMAC, it was thought that more time was necessary for members to assimilate the details and impacts of the proposals (see Annex F). This was recorded in the NATMAC 80 meeting notes:

NATMAC 80 PARA 10.2

South Coast Rationalisation. The proposal for the rationalisation of controlled airspace base levels along the South Coast and in the Thames Estuary had been the subject to a very short NATMAC consultation period due to the deadline for charting submissions. Representatives were concerned, however, that too little time had been allowed to fully consider the proposals and objections had been raised over service provision, flight in icing conditions and areas where it was considered that further rationalisation could be made, but where there was insufficient time to consider them. PPL IR, also raised the subject of alternative options such as changes to airspace classification to achieve the desired aim. Consequently, the **Chairman** accepted that, whilst the proposal had constituted a genuine attempt to secure a 'quick win' in terms of releasing controlled airspace, further scrutiny of the proposal was needed. The proposal would be put on hold to allow NATMAC Representatives to consider the proposal further.

23. Following NATMAC 80, no further feedback was received from NATMAC members. Therefore, the CAA has decided to re-examine this initiative once the outcome of the Farnborough ACP is determined and will notify NATMAC members in due course.

Condition 8 outcome

24. Regarding Condition 3, NATS complied with this condition and completed a review of the utilisation of this airspace. The outcome is:

1) For LTMA Sector 3 (3500+), no change was feasible due to the altitude of Gatwick, Southend and Biggin Hill arrivals.
2) For LTMA 8 Sector (5500+), whilst there were significant numbers of GAT flying through this airspace at 6000ft and above, NATS determined that there might be scope to raise part of this area. However, until the outcome of the Farnborough ACP has been determined, it was not

possible to determine what would be feasible. Therefore, it was agreed by the CAA that CTA bases to the south of the London Terminal Control Area (LTMA) would be reviewed after any decision on the Farnborough proposed controlled airspace change is made by the CAA. Therefore, the CAA has decided to re-examine this initiative once the outcome of the Farnborough ACP is determined and will notify NATMAC members in due course.

Data collected for the purpose of the PIR

Sources of Information

Change Sponsor

25. By letter of 20 May 2016, the CAA requested from the change sponsor the data sets/analysis attached at Annex A by 4 May 2017. This summary of evidence is also published on the CAA website. Due to the volume of data required, the collation process and sponsor review of the data prior to submission to the CAA, the data was actually provided to the CAA on 2 June 2017.

26. During the review process, the CAA considered:

- Bridge: the NATS anticipated impacts and benefits summary;
- Bridge Comms 1 complaints summary;
- Bridge Comms 2 complaints details;
- Bridge fuel CO2 analysis v 1.0;
- Bridge population overview analysis v2.0;
- Bridge safety confidential MORs-LAMP related;
- LAMP PIR requirements Master evidence providence by the sponsor;
- C11 Env C1, C2, C4 commentary summary by the sponsor;
- C11 E arr and W arr 70-00 track density plots;
- C13 PAT alerts;
- C Env 2 LC AONB comparison Arrival & Departures plots;
- Whisker Multi 2013 and 2016 easterly and westerly arrival altitude track dispersion plots in 1000ft intervals.

27. We have noted that the change sponsor provided all of the data requested. The evidence provided is published on the CAA website.

Operators and Airlines

28. (1) As highlighted in the Module B report, the CAA received some early feedback from some operators on issues with the naming of arrival procedures and associated issues with the loading of flight procedures into the aircraft FMS. This was quickly addressed and resolved – the detail is covered later in the operational issues section of this report.

(2) An issue was brought to our attention concerning some aircraft users experiencing difficulties with the procedure naming of the Biggin Hill transition arrival procedures in their navigation database – the detail is covered later in the operational issues section of this report.

29. NATS is the air navigation service provider (ANSP) currently providing air traffic control services for arrivals and departures at the Airport. On 20 May 2016, the CAA confirmed with NATS the PIR data submission requirements to enable the PIR to be analysed. This request was published on the CAA's website and the response is included at Annex A and on the CAA website together with all the data provided.

30. Regarding the Annex A requirements, NATS provided evidence to satisfy all the PIR requirements. Some database coding issues had already been brought to the attention of the CAA during the first year of operations (as alluded to above). Specific aspects are considered in more detail later in the report.

Other data we have considered

31. The CAA and change sponsor have received feedback from groups and residents much of which was directly related to the issues that the CAA required to be considered under the terms, scope and objective of this PIR. Groups and residents local to LCA have raised complaints on aircraft noise, overflight and concentration of flight paths with the airport and the CAA – this was covered by Module B PIR report.

Objectives and Anticipated Impacts

The original proposal and its objectives

32. The original airspace change proposed changes to portions of the London City Airport and Biggin Hill arrival and departure routes above 4,000ft. Fifteen new Standard Arrival routes (STARs) and six new arrival transition procedures would be introduced to facilitate RNAV-1 arrival connectivity between the en-route airway structure and London City and Biggin Hill Airports. Five STARs to Gatwick would be realigned, and seven new STARs to Southend Airport would be introduced.

33. Six SIDs from London City would be replicated along their entire length, ending at Clacton, Brookmans Park and Compton VORs. For departures to the south, the six conventional SIDs to Southampton, Dover and Lydd would be replaced by two RNAV-1 SIDs to EKNIV.

34. The objective of these changes was to introduce a new, more efficient, system of RNAV-1 routes to replace the conventional procedures in use prior to the change.

Anticipated Impacts

35. We determined that the new RNAV-1 procedures would provide a benefit to those operators whose crews and aircraft flying into London City are approved and certified to fly RNAV-1 procedures; at the time of the ACP submission, the estimate was that on implementation, this equated to 70% of all operators. In our Decision document, we stated that until such time when a UK mandate for RNAV-1 operations became effective (at that time the estimate was November 2017 but this mandate has since been withdrawn in light of changes planned for future airspace modernisation under Future Airspace Strategy Implementation (South)), non-RNAV-1 operators would be able to fly the existing conventional SIDs. The non-RNAV-1 southerly departures would receive radar vectoring to follow the departure track of the RNAV-1 SIDs to gain height to cross above the inbound traffic, and the non-RNAV-1 inbound traffic will continue to be radar vectored into the arrival sequence.

36. Traffic inbound to Southend would also see revised routeings via the GEGMU STARs from the east, south and south-west. The airspace design was to ensure that this traffic is safely separated from the London City routes, and a more predictable flight path provides certainty to crews regarding their routeing, although there would be some increased track mileage with the new STARs. Compared with the techniques used due to airspace constraints, it was expected that pilots would have a better awareness of the expected route in advance, and the route from airway to runway would be defined in the aircraft's Flight Management System (FMS).

37. We concluded that overall these proposals would achieve a net benefit in terms of fuel savings (and less CO_2 emissions) for aircraft using London City. We did note that aircraft operating specifically from London City to and from airports in the north of the UK will fly extra track miles due to the revised inbound route from the north. In our view however, we thought that this was more than offset by the benefits achieved by improved climb profiles for all aircraft using London City and the higher and re-profiled arrival flight paths which burn less fuel and that the proposal would also result in less holding at low altitudes. The CAA's Module C Operational Assessment and Environmental Assessment provided the relevant data.[2]

38. A summary of the anticipated impacts on CO_2 emissions from the LAMP Phase 1A Modules was attached at Appendix 1 to the Environmental Assessment submitted by NATS to the CAA along with the LAMP Phase 1A airspace change proposals Modules A – E.3

39. We concluded that the changes proposed in this Module were likely to benefit air navigation service providers as it is anticipated that air traffic control workload would reduce as a consequence of this change and the changes in the other Modules. This would provide both safety and capacity benefits.

40. The CO2 assessment of this Module was combined with that of Module B in the original proposal. The anticipated combined CO_2 reduction for Modules B and C was estimated to be with the range of 10,100-20,200 tonnes in 2016. In addition, as discussed in the CAA's Environmental Assessment, overall, the LAMP Phase 1A package of proposals was anticipated by NATS to provide an estimated 34,900 tonnes of CO_2 savings in 2016. Fuel savings were predicated

[2] http://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Decisions/London-Airspace-Management-Programme-Phase-1A/.

[3] http://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Decisions/London-Airspace-Management-Programme-Phase-1A/.

on a number of factors and were calculated for a series of scenarios for 2016 and 2020 timelines. Taking a more conservative assessment, for the purpose of making this decision we concluded that we anticipated that the LAMP Phase 1A changes overall, (as enabled by Module C) would deliver a reduction of approximately 17,400 tonnes of CO_2 in 2016 and 20,800 tonnes in 2020.

41. Since this proposal and the other airspace changes within LAMP Phase 1A required no changes to ground infrastructure, we anticipated that there would be no effects on biodiversity.

42. Since the proposed change did not alter operations below 1000ft AMSL we anticipated there will be no effect on local air quality.

43. We assessed the anticipated impact of noise emissions on the changes proposed. When doing so we had regard to the altitude based priorities as given to the CAA by the Secretary of State in the 2014 Guidance to CAA on Environmental Objectives (set out in Annex A to the CAA Decision: Part applicable to each LAMP Phase 1A Modules A – E.

44. We had further had regard to the 2014 Guidance which addresses the impact of new technology of the type that is the subject of this proposal as follows:

"With PBN, the overall level of aircraft track-keeping is greatly improved for both approach and departure tracks, meaning aircraft will be more concentrated around the published route. This will mean noise impacts are concentrated on a smaller area, thereby exposing fewer people to noise than occurs with equivalent conventional procedures.

…Concentration as a result of PBN is likely to minimise the number of people overflown, but is also likely to increase the noise impact for those directly beneath the track as they will be overflown with greater frequency than if the aircraft were more dispersed.

…The move to PBN will require the updating of existing route structures such as Standard Instrument Departures (SIDs), Standard Terminal Arrival Routes (STARS) and Initial Approach Procedures (IAPs). Updating individual routes in terminal areas can fall into one of two categories: "replication" where the existing route alignment is preserved as much as possible whilst catering for the greater navigational accuracy of PBN, or "redesign" where seeking to

optimise the introduction of PBN will require consideration of a different alignment.

For replication, the requirement is to preserve the existing route alignments as far as possible"

45. We concluded that we did not anticipate there would be a significant impact on noise emissions (within the meaning of Paragraph 9 of the Secretary of State's 2001 Directions to the CAA). See the incorporated **CAA Decision: Part applicable to each LAMP Phase 1A Modules A – E**, Annex A for an explanation of the CAA's policy in this regard. As set out in the CAA Environmental Assessment this was because the proposed changes to both departure routes and arrival routes would have no anticipated impact upon the airport's L_{eq} noise contours.[4]

46. We noted that the proposal contained changes that would result in new tracks over the ground although this would occur for aircraft that would be above 4000ft AMSL. Notwithstanding that we did not anticipate a significant noise impact we did consider that there is still likely to be a noise impact of the proposal. Experience of implementation of RNAV-1 departures and procedures at other airports lead us to conclude that aircraft would more accurately fly the nominal track of the RNAV-1 route and would consequently exhibit more concentrated tracks over the ground than aircraft flying the extant conventional departures in use prior to the change.

47. Our experience of the implementation of RNAV-1 Departures at Gatwick Airport in November 2013 (and its post implementation review in 2015) also lead us to anticipate that aircraft would remain concentrated on the nominal track of the RNAV-1 SID longer than appeared to be the case when all aircraft were flying conventional SIDs, even above 4000ft AMSL. We also anticipated that the RNAV-1 arrivals for London City and Biggin Hill would be more concentrated than is currently the case.

[4] Leq contours are a method of portraying averaged noise levels, overlaid on a map so that locations can be easily identified. More detailed information about Leq noise contours can be found at the CAA's website http://www.caa.co.uk/Environment/Environmental-information/Information-by-environmental-impact/Noise/Measuring-and-modelling-aviation-noise/Measuring-the-impact-of-continuous-noise/.

48. For both departure and arrival traffic, on implementation of this proposed change, only 70% of flights would be approved for RNAV-1 operations. The other 30% of traffic would be likely to continue to exhibit the existing dispersion of non–RNAV-1 traffic. Therefore, we anticipated some variance from the expected amount of concentration until full RNAV-1 compliance is achieved.

49. We took into account that that the impact of this anticipated concentration would relate to aircraft flying at 4000ft AMSL and above. We had regard to the Secretary of State's altitude-based priorities as regards the environmental impact of proposed airspace changes. (See Annexe A of CAA Decision: Part applicable to each LAMP Phase 1A Modules A - E).

50. We took into account that, in our view, some residents experiencing aircraft noise prior to the change were likely to experience less noise because the proposed changes in this Module were anticipated to enable aircraft to climb higher, sooner, whereas the airspace design prior to the change required aircraft to be kept lower for a longer period.

51. We concluded that the proposal may have had an effect upon tranquillity and visual intrusion over Areas of Outstanding Natural Beauty (AONBs).

52. We concluded that we anticipated that the two AONBs in the Kent Downs area were likely to experience an improvement in tranquillity and visual intrusion impacts. The changes proposed in this Module and in the LAMP Phase 1A proposals overall would typically result in aircraft being at greater heights over the Kent Downs area than was previously the case. The proposed re-routeing of London City inbound traffic further to the east, which would overfly Dover at 10,000ft AMSL, would impact a smaller area due to the displacement of aircraft to the east. At worst, there was unlikely to be an increase in the existing impacts over the AONBs in this area. If anything, there may have been an improvement because aircraft would be higher overland as they cross this area.

53. In comparison, we concluded that there may be an impact upon tranquillity and visual intrusion for the Dedham Vale and Suffolk Coast & Heath AONBs arising from the proposal due to additional aircraft above this area. NATS concluded this would be an average of two extra aircraft per hour at heights of typically 12000ft AMSL and no less than 8000ft AMSL, and we agreed that this was a reasonable conclusion. On that basis, we concluded that any impacts on tranquillity and visual intrusion for these areas were likely to be minor, if at all. When taking this impact into consideration we had regard to the Secretary of State's altitude-based priorities set out in the 2014 Guidance to CAA on

Environmental Objectives (set out in Annex A to the CAA Decision: Part applicable to each LAMP Phase 1A Modules A – E).5

54. Having carefully considered this information we concluded that overall, the proposals in Module C contributed to and enabled the environmental benefits anticipated as a consequence of the package of proposals in this Module and in all the LAMP Phase 1A Modules considered together. We acknowledged that some new areas would be overflown, above 4000ft AMSL and that these areas may experience the noise impact of concentration that is a consequence of RNAV-1 procedures, and the possible impact on some AONBs, described above.

5 Which states that where practicable, and without a significant detrimental impact on efficient aircraft operations or noise impact on populated areas, airspace routes below 7000ft AMSL should, where possible, be avoided over Areas of Outstanding Natural Beauty and National Parks as per Chapter 8.1 of the 2014 Guidance.

CAA Assessment

Operational Assessment

55. The CAA examined the track data plots presented by the sponsor and reviewed the evidence provided by the sponsor with regard to the set of PIR reporting requirements as highlighted at Annex A. We completed a detailed analysis of all the new procedures flown and compiled a report which is at Annex B. In the track data analysis at Annex B, the SARG IFP regulator recorded whether the procedures were being flown correctly by the operators, and if not, particular issues were highlighted. We also took account of feedback from operators and engagement with database coding houses as illustrated earlier in paragraph 28. The following is a summary of the CAA's conclusions.

Safety

56. From the evidence supplied in Annex A (the evidence provided in accordance the PIR requirements), there were no Mandatory Occurrence Reports (MOR) raised by NATS in relation to the particular scenarios where we sought feedback given the nature of some of the design characteristics used for the departure and arrival procedures. We therefore conclude that the procedure designs have been successful in this context.

57. As NATS reported in their Anticipated Impacts and Benefits statement, as a result of the implementation of LAMP Phase 1A, the controller workload in the London Terminal Control ("TC") Thames sector has been greatly reduced as a result of the new systemised airspace design with much less tactical control at low levels overland within a congested area close to the airport. This has resulted in an improvement in safety risk within the Swanwick TC environment and, with the TC Thames sector. Whilst this is evident across the regions affected by change in Modules B and C (the network changes), the particular benefits within this Module are associated with the reduced controller workload in sequencing and managing the arrival flows for LCA, integrating the systemised EKNIV SID departure route traffic which is designed to reduced radar vectoring and controller workload by enabling departures to the south to be climbed above all the arriving traffic, a factor which was previously tactically managed by controllers before the change. The CAA recognises that the design has been successful in this regard, and that flight safety has been improved with the changes implemented in this Module.

58. Whist there is a slight overlap with Modules B and C where the changes are portrayed in respective consultation areas, under PIR requirement B14 in Module B, NATS was advised to report on any inadvertent penetration of the Southend controlled airspace by traffic arriving into or departing from London City which resulted in an MOR being raised. There were no occurrences reported under the MOR reporting system.

59. Similarly, whist there is a slight overlap with Modules B and C where the changes are portrayed in respective consultation areas, as covered in the Module B PIR report during the last year, whilst not specifically reported to the CAA, we became aware of a number of situations when aircraft on departure routeing to the east/south east have not been climbed soon enough to remain inside controlled airspace.

60. Prior to LAMP 1A designs, there had been a long-standing procedure with departures to the south east which are technically capped by the SID design at 3000ft (as are all other departures) following an incident in 2010; this means that aircraft require climb instructions above 3000ft to be issued by ATC as soon as they are clear of other traffic. For LAMP 1A post implementation, given the requirement for ATC to climb departures above the arrivals, there was always a necessity to give the climb to departures early enough to establish vertical separation prior to the cross-over of both departing and arriving flightpaths. Since implementation, whilst it became apparent that some aircraft have inadvertently left controlled airspace for a short period until climb instructions have been issued by ATC, we became aware of a number of 'in house' procedures which NATS are using to alleviate this situation, and furthermore, at the time of writing this report, there has been a reduction in such occurrences. Although not attributable to the new airspace design, as the situation existed prior to implementation, the CAA will nevertheless continue to monitor developments.

61. The CAA also noted that from the evidence provided under Module B PIR requirement B8/9/10, whilst forecast RNAV at the time of the ACP submission was estimated at 70%, the actual usage over the first year rose to 92.6%, although in the last quarter of the annual period (4 Nov 16-3 Feb 17) the actual usage was 95.9%. The CAA would comment that the increased RNAV utilisation is also an added benefit in this Module where changes were implemented, in that there is less radar vectoring for non-RNAV-1 aircraft, and hence reduced controller workload; consequentially, this is a contributory factor to an improvement in flight safety for both flight deck crews and air traffic controllers.

Operational Feedback

Flyability.

62. Under PIR requirement C6, we asked NATS to provide details of any issues with flyability of all SIDs and arrival transitions. There were none known to NATS as highlighted in the Master Evidence C6 (Annex A). In the absence of any further reports of any flyability issues (other than the procedure identification issue outlined above), we therefore conclude that all the procedures have been flown to a satisfactory standard). However, we have a few observations to make regarding the actual track dispersion achieved not necessarily associated with flyability.

Observations from Track Analysis in Annex B

- **Runway 09 ODLEG arrival transition.**

The point merge procedures appear to work as they were designed to.

It would appear from the density plots that the majority of inbound flights are being radar vectored or provided with direct routeing to OSVEV to some degree.

From OSVEV to ODLEG, the transition as published in the AIP is being flown as expected. Having checked the altitude details in the “Whisker Multi 2016-02(05, 08 & 11) -E Arrs” the altitude adherence is as expected.

- **Runway 27 LAVNO arrival transition.**

The point merge procedures appear to work as they were designed to.

The transition as published in the AIP is being flown as expected.

A lot of ATC radar vectoring or direct to routeings can be seen occurring up to TOPDU and LAVNO.

Having checked the altitude details in the “Whisker Multi 2016-02(05, 08 & 11) -W Arrs” the altitude adherence is as expected.

- **LCA EKNIV SIDs departing to the southeast/south**.

- The RNAV density plots appear to indicate that vectoring is taking place later (commences at the 3rd last dot) than can be seen on the conventional SID.
- **Southend RNAV STARs.**

There were no reported issues.

- **Gatwick RNAV STARs.**

There were no reported issues.

Arrival Procedure Identification in Aircraft FMS

63. We determined that while the arrival procedures were being flown by the operators as intended, it was brought to our that the initial introduction of the procedure caused confusion for some operators. This was where some operators were unable to select the STAR and arrival transition procedures as cleared by ATC. This meant that ATC had to provide radar vectors until the various procedures had been recoded/renamed which took some time before all were corrected. The issue was highlighted by NATS under PIR Requirement B12 evidence (see Annex A). As part of the PIR, we have determined that the "Transition Arrival" charts will need to be renamed as "Approach transition" by the procedure sponsor. Action will be initiated by the CAA Instrument Flight Procedures (IFP) Airspace Regulator to address this technicality.

Note: whilst this mainly affects the arrival procedures under the jurisdiction of Module C, this is included here for reference as the arrival procedures cover changes proposed in both Modules B and C.

64. After the introduction of these procedures in 2016, a subsequent requirement as defined in the EASA Reg (EU) 2017/373 requires the UK to comply with the ICAO STAR naming convention. The current UK naming convention for STARs and arrivals is currently predicated on the last waypoint of the procedure, whereas the ICAO naming convention is predicated on the first waypoint of the procedure. This difference means that all London City STARs/Arrivals will need to be renamed in due course; however, we would highlight that this is a procedure naming issue and will not affect any of the aircraft tracks over the ground. Therefore, to comply with this requirement, it is now recommended that London City STARs and Arrival transitions be re-named once co-ordination between the CAA and NATS has been initiated and appropriate action is agreed to address the issue.

65. An issue concerning some aircraft users still experiencing difficulties with the procedure naming of the Biggin Hill transition arrival procedures in their

navigation database has recently been brought to the attention of the PIR team who have been carrying out the post implementation analysis. As this has only come to light to the PIR team in the very late stage of drafting this report, this will now be investigated to enable a full understanding of the issue before any conclusion and recommendations can be reached.

Air Navigation Service provision

66. There has been adequate resource for service provision to arrival and departures for the elements of the LAMP 1A design in Module C. With the expanded area of operation for the Thames Radar sector to manage the arrival flows from the STAR Holding patterns and integrate the EKNIV departures before transferring to the next TC sector the changes brought about a more systemised approach to manage the traffic flows with a clear delineation of controller responsibilities. The Thames sector is split according to traffic demand and complexity, but it can still be managed in a bandboxed[6] configuration it there is little demand in the quieter periods.

With regard to other sectors where changes were made to Gatwick and Southend procedures the changes had no impact on ATC staffing or resource.

Utilisation and Track Keeping

67. The CAA carried out an in-depth analysis of the traffic patterns achieved by viewing traffic samples for selected periods during 4 seasonal months throughout the first year of operation. The analysis report is detailed in Annex B. The traffic samples are included on the CAA website. To understand the impacts, interested parties should read the guidance in Annex B before reading the track analysis and associating the comments with the relevant diagrams.

68. We found that:

London City Procedures.

(1) Procedures were being flown correctly by the operators.

(2) The track keeping of the London City procedures was as expected.

(3) Direct routeings to waypoints were obvious on the track plots when traffic conditions permitted shorter routeings to be provided – this would either have been radar vectoring (potentially for the very small number of non-

[6] Banboxed: this means a combined sector with one controller as opposed to two sector controllers.

RNAV-1 equipped aircraft) or instructions to route to a particular waypoint to save track mileage and provide a more expeditious routeing; for example, for the Runway 09 arrival direct routeings to OSVEV are very noticeable.

Extracts from the NATS Module C commentary - PIR Requirement C11

Note: For cross referencing see the relevant document via the associated links in red.

C01-C11 slide 3 – London City Arrivals.

69. NATS advised that the pre-implementation arrival arrangements showed that arrivals were spread over a wide area of land, at altitudes below 7,000ft. The post-implementation point-merge structure showed the merge arcs operating as predicted, with a concentration of flights mainly over the estuary towards the merge point descending to 6,000ft and then following the appropriate arrival transition (Module B).

70. In quieter periods, Runway 27 (Westerly) arrivals either follow the transition straight down the river, or are tactically directed towards the transition waypoints ATPEV or TOPDU descending to 4,000ft and on to Module B's remit.

In quieter periods, Runway 09 (Easterly) arrivals are tactically directed towards the start of the pre-implementation downwind leg descending to 4,000ft, thence to OSVEV and on to Module B's remit.

C01-C11 slide 4 – London City Network – AONB Arrivals.

71. NATS advised that the pre-implementation arrangements showed that arrivals were spread over a wide area of land, at altitudes below 7,000ft. Waypoints DET and SPEAR were aiming points for London City arrivals. DET is in the middle of the Kent Downs AONB, and almost all arrivals from the southeast overflew Kent Downs AONB below 7,000ft. Arrivals from the south sometimes overflew High Weald AONB below 7,000ft en route to DET and the Kent Downs AONB. SPEAR has no adjacent AONB. There was no evidence of overflight of Dedham Vale and Suffolk Coast & Heaths AONBs by London City arrivals below 7,000ft.

72. The post-implementation arrival arrangements showed that traffic stays higher and is generally converging over the estuary around 7,000ft. The density plots show that far fewer flights arrive over the Kent Downs AONB and almost none over High Weald AONB below 7,000ft, due to this procedure. There was no evidence of overflight of Dedham Vale and Suffolk Coast & Heaths AONBs by London City arrivals below 7,000ft.

C01-C11 slide 7 – London City Network – AONB Departures.

73. NATS advised that the pre-implementation arrangements showed that departures were spread over a wide area of land, at altitudes below 7,000ft. Many southeast-bound departures were kept below 7,000ft and were tactically vectored southeast across Essex and Kent in wide swathes. Some crossed the Kent Downs AONB below 7,000ft. There was no evidence of overflight of High Weald, Dedham Vale and Suffolk Coast & Heaths AONBs by London City departures below 7,000ft. Many departures via CLN to the northeast were tactically vectored northeast as required. Most BPK/CPT departures headed to BPK and many were tactically vectored northwest or west as required.

74. NATS commented that the post-implementation departure arrangements show that traffic gets higher quicker, and follows narrower overall paths. Of particular note, most southeast-bound departures were climbed above 7,000ft before SODVU and the turn southeast towards EKNIV. Departures via CLN and BPK had similar tactical vectoring, also in a generally narrower overall path. There was no evidence of Kent Downs AONB overflown below 7,000ft. There was no evidence of overflight of High Weald, Dedham Vale and Suffolk Coast & Heaths AONBs by London City departures below 7,000ft. For the London City network changes, NATS concluded that:

Arrivals stayed over the sea for longer, and in a narrower area over land than pre-implementation. Departures climbed higher quicker, and stayed in a narrower area than pre-implementation. Fewer flights occurred over AONBs.

The post-implementation arrangements are consistent with the predictions made in the consultation material.

Traffic

75. Given that the new LAMP1A departure and arrival procedures covered within Module B were introduced in areas of controlled airspace which were unchanged, there has been no impact on other airspace users. The traffic patterns observed appear to be in the main, as forecast by the sponsor and therefore, we would conclude that operational impacts have been as expected. For operators flying into LCA, the RNAV-1 procedures have produced benefits by reducing both controller and flight deck workload as a result of less radar vectoring compared with the situation prior to the change. Note: It is however noted that certain operations (mainly those to and from the north and the few flights that fly in and out on westerly routeings from and to Ireland / USA have experienced extra track mileage and flight times – this is more a result of the changes in Module C and is covered in the Module C report.

Environmental Assessment

76. The sponsor provided its analysis of the environmental impacts (see Annex A of this report for a list of information provided) for the airspace change post implementation review. The CAA has assessed that data and the details of that assessment are set out below.

77. It should be noted that at the time of the consultation and decision on this Module, the CAA's PBN SID Replication Policy was current and therefore its reduced requirements were applied to this Module.

Noise

78. All of the airspace design changes within Module C are for procedures that are at 4000ft and above. These changes all occur far beyond the extent of London City Airport's 57 dBA L_{eq} noise contour. (The same is true of any of the changes affecting traffic associated with Biggin Hill). On this basis, we conclude that the airspace change has not resulted in an unexpected increase in people significantly affected by noise, as defined in our original decision.

Overflights

Summary of "overflight" impacts, as presented in the PIR data from the sponsor:

79. The table and accompanying text should be read in conjunction with the further information at Annex C of this report. Population counts in the table have been rounded to the nearest 100, and therefore differences will be due to rounding.

Modules B & C – London City	Pre-implementation (2013)	Post-implementation (2016)	Increase / decrease
Arrivals			
Direct overflight - Ground to below 4,000ft	881,000	331,000	-550,000
Direct overflight - 4,000ft to below 7,000ft	404,900	72,100	-332,800
Direct overflight - Ground to below 7,000ft	1,285,900	403,100	-882,800
"CAP1498 swathe"	2,439,700	1,231,300	-1,208,400
Departures			
Direct overflight - Ground to below 4,000ft	672,900	416,300	-256,600
Direct overflight - 4,000ft to below 7,000ft	184,800	115,100	-69,700
Direct overflight - Ground to below 7,000ft	857,700	531,400	-326,300
"CAP1498 swathe"	1,447,200	1,317,100	-130,200

Note: The Arrivals and Departures population counts cannot be combined to show a total because some of the geographic areas are common to both Arrivals and Departures, especially for the pre-implementation traffic patterns.

80. NATS has not used the CAP1498 “overflight” methodology to produce a set of contours which would have given a clearer picture the proportion of the population that are being overflown more often as a result of the airspace change.

81. So in the case of Modules B & C, a possible proxy for gauging the population being overflown more often would be the headcount for those within the direct overflight totals (the shaded cells in the table above).

82. Therefore, whilst it is apparent that using the simplified CAP1498 swathe shows that there has been a reduction in the population overflown below 7,000ft, the shaded cells in the table show that there is a portion of the population that is likely to be experiencing an increase in being overflown as a direct result of this airspace change, regardless of the increase in traffic volumes that has occurred in any event.

Arrivals - From 4000ft to 7000ft:

83. The reduction in overflight in this altitude band is as a result of a distinct change in traffic pattern resulting from the introduction of Point Merge. This has reduced the number of aircraft arriving over Hertfordshire, North London, East Essex and North Kent in this altitude band. The one location that appears to be overflown more often as a result of change in traffic pattern (other than as a result of concentration) is the Hoo Peninsula/Isle of Grain. This was not an expected impact of the proposed change; the expected traffic pattern as portrayed in the sponsor’s submission (“Design Report Following Consultation Feedback on Route Network (above 4,000ft) over Sussex, Essex and Kent” Issue 1.0) only shows arriving aircraft using the arrival procedures (i.e. no indication of vectored aircraft) and does not indicate that this location was expected to be overflown more often by aircraft as a result of the airspace change.

84. Whilst this change in traffic pattern was not anticipated, this location is sparsely populated and was already being overflown (to a lesser extent) prior to the airspace change. Even though some residents may be experiencing an increase in noise impact, that will not represent a significant change under the ANG 2014 due to the altitude and frequency of the aircraft that are now —— overflying that area.

Departures – From 4000ft to 7000ft:

85. The reduction in overflight in this altitude band is primarily as a result of a change in the shape of the traffic pattern. There are much fewer flights heading east across South Essex, coupled with an apparent improved climb profile meaning that aircraft tracks are generally shorter, and therefore overflying a smaller geographic area below 7000ft. In the original consultation and proposal, the sponsor indicated that because aircraft could be tactically vectored from 4000ft, they did not anticipate any change in traffic patterns above that altitude. In our consideration of the impacts when making our decision on the original proposal, we noted that our experience of previous SID "replications" for other airspace changes when PBN SIDs are introduced suggested that concentration also occurs above the height at which tactical vectoring is possible. This was our expectation at the time of the decision, and the above assessment of the overflight analysis supports that expectation for departures between 4000ft-7000ft.

Areas of Outstanding Natural Beauty and National Parks

86. The potential impacts upon Areas of Outstanding Natural Beauty and National Parks were considered as part of our original decision on Module C. The impacts evident from the PIR data support the expectations that:

- There are no AONBs or National Parks that that are overflown more often below 7000ft than prior to the airspace change;
- The previous pattern of traffic over the Kent Downs AONB has improved, with fewer and more dispersed aircraft flying over this area below 7000ft.

On that basis, we conclude that there are no unanticipated impacts in terms of tranquillity on AONBs or National Parks.

CO_2 Emissions

87. Further detail of the PIR assessment of the change in fuel burn and CO_2 emissions can be found in Annex D of this report which summarises the impacts across all of the LAMP Phase 1A Modules. The assessment of CO_2 emission that supported the original airspace change proposal and which the CAA took account of in making its decision was a combined assessment that reflected the totality of the changes related to London City Airport (i.e. Modules B and C). In the same way, the CO_2 assessment for the PIR has also combined these two Modules. That said, the expectation was that the majority if not all of the change in CO_2 emissions would relate to Module C because that

was the Module that reflected the large changes to the arrival routes. By comparison Module B was intended to be a "replication" of the existing departure and arrival routes, and therefore was not expected to have any notable change in CO_2 emissions.

88. In the original ACP, the fuel burn and CO_2 estimates for London City routes did reflect the sponsor's expectations of an increase in track mileage generally for arrivals, but also balanced this against expected savings in both holding time and improved vertical profiles for arriving aircraft. The result was that fuel savings and CO_2 reductions were forecast for London City flights.

89. The PIR assessment shows that Modules B and C have not achieved a CO_2 reduction in line with the estimated change in emission that was proposed and considered when the CAA made its decision to approve the airspace change. On the contrary, the emissions assessment indicates that rather than deliver an anticipated reduction in CO_2 emission, these two Modules have resulted in an increase in emissions. This is due to the change in the arrival routes not delivering the expected benefit rather than a result of the changes made to the departure routes.

Environmental Conclusion

90. The CAA's conclusion in this PIR is that the environmental impacts consequential on the implementation of any of the changes are as expected and are consistent with the impacts we took into consideration in making our original decision other than:

- The evident pattern of vectored tracks from arriving aircraft below 7000ft across the Hoo Peninsula/Isle of Grain. Whilst this change in traffic pattern was not anticipated, this location is sparsely populated and was already being overflown (to a lesser extent) prior to the airspace change. Even though some residents may be experiencing an increase in noise impact, that will not represent a significant change under the ANG 2014 due to the altitude and frequency of the aircraft that are now overflying that area.

  Notwithstanding this, we will require the sponsor to examine why this has occurred and determine what action is appropriate.

- The CO_2 emissions impact noted above. We are therefore asking NATS to investigate why there is this variation between the forecast benefits and the actual fuel and CO_2 disbenefit and report on the reasons more fully.

Community Stakeholder observations

91. As part of the data collection process, the change sponsor was required to accept, process and collate noise enquiries/complaints and feedback relating to the implementation of this airspace change.

92. A total of three complaints fall within scope of this review and these were generated by individuals residing in three different locations; one individual complained directly to the change sponsor, whilst the other two addressed their complaints to the CAA.

93. Focussing initially on the individual which complained to the change sponsor, the CAA was unable to determine their exact location as they had failed to provide confirmation of their postcode. However, they did confirm they live in Staple, Kent, a village which lies within close proximity of the centreline for the southerly entrance route into the Point Merge procedure. The individual referenced an increase in noise levels and highlighted that the traffic patterns are particularly 'dense' in the morning and early afternoon; such observations are consistent with the traffic patterns we were expecting to see and therefore do not give rise to any unforeseen impacts of the proposal. The individual also stated that they were not aware of any related consultation and suggested that the associated communication strategy was insufficient to reach the parts of East Kent that were most likely to be impacted by the implementation of the proposed change. The CAA notes that Kent County Council, Dover District Council and the Member of Parliament (MP) for South Thanet were all identified as stakeholders by the change sponsor and therefore that they would have been consulted on the proposed change; the Module C Stakeholder Organisations and General Public Consultation Final Report confirms that both Kent County Council and Dover District Council responded to the consultation.

94. Turning now to the two complaints received directly by the CAA, one was generated by an individual who resides on the Hoo Peninsula, Kent and their property is located approximately 1.5 miles to the south of the procedure's centreline. Their complaint recorded an increase in the volume of low flying aircraft and the associated noise impact, whilst highlighting that they were not consulted about these changes. Whilst the CAA acknowledges that this is a

single complainant, it also notes that the Hoo Peninsula is a sparsely populated area and that the content of this complaint does reinforce a conclusion made earlier on in this report with regards to the pattern of arrivals between 4,000 and 7,000 feet (see Paragraph 72). With regards to the suggested lack of consultation, the Hoo Peninsula falls within the boundary of Medway District Council and is represented by the MP for Rochester and Strood. The change sponsor had identified both as stakeholders and therefore they would have been consulted on the proposed change; the Module C Stakeholder Organisations and General Public Consultation Final Report confirms that both Medway District Council and the MP for Rochester and Strood responded to the consultation.

95. The other complaint addressed to the CAA was from a resident of Aveley, which lies directly under the centreline for the westerly arrival transition procedure and is located just to the east of the LAVNO waypoint. The complainant recorded an increase in aircraft passing overhead and reported that this has increased the aircraft noise levels experienced at their property. Such observations are consistent with the traffic patterns we were expecting to see and therefore do not give rise to any unforeseen impacts of the proposal.

96. To summarise, we have analysed the complaints received by the change sponsor and the CAA as part of this Review. As a result of our analysis, we have concluded that, for the most part, the themes are consistent with the traffic patterns that we were expecting to see. However, the single complaint from the Hoo Peninsula suggests that an area to the south of the procedure centreline is being overflown on a frequent basis and such a traffic pattern is not consistent with what we were expecting to see. The result is overflight of areas not predicted as described in paragraph 90.

Ministry of Defence Operations

97. Operations by the Ministry of Defence were not affected by the proposals in Module C.

Conclusion

Operational Conclusions

98. No MORs relating to procedure designs and flyability were attributed to any scenarios where we specifically as requested feedback. We therefore conclude that the procedure designs have been successful in this context.

99. Early issues with the naming of the arrival procedures which were loaded onto some operator's (but not all operators) aircraft flight management systems were resolved once the issues had been investigated. This was a database coding issue with procedure naming conventions and not associated with the actual designs themselves. The SARG IFP regulators have noted these issues and will ensure that future designs are named appropriately.

100. An issue with the naming convention of the Biggin Hill arrival transition is to be investigated and discussed between the SARG IFP regulators and NATS in order to determine any action as appropriate in order to resolve the issue.

101. ATC complexity has been reduced by the introduction of RNAV1 procedures which has reduced ATC workload, which in turn reduces flight deck workload and RT transmissions between ATC and flight crews due to the more systemised nature of operations which has meant less radar vectoring by controllers. This has been a positive impact on flight safety. The benefits of the RNAV Design have been realised by more operators than perhaps first though as RNAV 1 equipage rates have risen from an estimated 70% on implementation to almost 96% at the end of the first year of operations.

102. The EKNIV SIDs have seen an improved climb performance for departures flying to the southeast and south.

103. The change proposal has delivered the operational objectives and benefits which were anticipated in consultation and have been successfully implemented from an operational viewpoint.

Environmental Conclusion

104. The noise impacts are consistent with the impact anticipated in the airspace change proposal. On that basis, we consider that there has been no increase in the number of people significantly affected by noise as a direct result of the airspace change.

105. As anticipated, there has been a net reduction in the number of people overflown, whilst there is also a proportion of the population that are being overflown more often.

106. This Module, in conjunction with Module B, has not achieved the reduction in annual CO_2 emissions that was expected. Instead these two Modules have resulted in an increase in CO_2 emissions.

107. With the exception of the one instance highlighted in this report the traffic pattern anticipated and as shown in consultation has been realised

Overall Conclusion and Confirmation of LAMP Phase 1A Implementation

108. In respect of Module C of LAMP Phase 1A the CAA confirms that the operational aims and objectives have been achieved. No modification of the RNAV-1 arrival and departure designs are required by NATS except for the chart change and database coding change modification as discussed in paragraph 63-65. This concludes the CAA's airspace change process in respect of London City Airport's airspace change request dated 16 February 2015.

109. Notwithstanding our overall conclusion, in view of the one difference of actual and forecast track dispersal as shown in the consultation feedback report, we recommend that the sponsor examine why the unpredicted overflight of the Hoo Peninsular has occurred and to determine further action, if any.

110. With respect to the variance from the forecast CO_2 emission benefits and the actual CO_2 benefits realised, we recommend that the sponsor investigate why the change proposal has not achieved the forecast fuel and CO_2 benefits.

Note on plain language

111. The CAA has attempted to write this report as clearly as possible. Our approach has been to include all the relevant technical material but also to provide a summary and of the conclusions the CAA has reached in reliance on it in as understandable a way as possible. Nevertheless, when summarising a technical subject there is always a risk that explaining it in more accessible terms can alter the meaning. For that reason, the definitive version of our assessment and conclusions are in the attached technical reports.

Annexes

Annex A. LAMP Phase 1A PIR data provision Requirements - evidence provided.

Annex B. London City Airport Arrival and departure Track Analysis Assessment.

Annex C. LAMP PIR Bridging Module Analysis – Changes to population overflown by Modules A, B and C (Version 2)

Annex D. CO_2 Emissions Summary

Annex E. Presentation to NATMAC on controlled airspace lower limit revision.

Annex A - LAMP Phase 1A PIR data provision Requirements - evidence provided.

Data for the PIR review is to be submitted to the CAA by [agreed date in 2017] unless stated otherwise in the remarks column where specific actions are required to be completed in accordance with the CAA Decision Documents dated 22 December 2015 as amended.

The following Notes relate to data provision regarding the format of submission material and responsibilities of the appropriate LAMP sponsors.

In the Table below, the last column indicates responsibility for the appropriate LAMP sponsor to provide data as appropriate; in some circumstances, this responsibility is to be shared as agreed between sponsors.

Note 1: NATS, London City Airport Ltd and London Stansted Airport Ltd are to collaborate to produce a joint PIR to match the collaborative ACP. References to 'LAMP Sponsors' in the remarks column refer to the collective.

Note 2: MOR analysis: A number of the remarks below relate to MOR analysis. NATS is to monitor MORs generated within the region and highlight any significant issues that require further investigations to the case officer as they arise. A complete MOR summary for the year post implementation is to be provided with the PIR in May 2017. It is noted that overloads are reported as a subset of MORs.

Note 3: Density and track plot maps: NATS is to aim to produce directly comparable maps across the whole LAMP 1A region. However, given that NATS is upgrading their track processing technology, it is understood that this may mean data presentation

tools change from those used in the consultation. The CAA recognises that this in turn may make it impossible to produce new maps that are directly comparable to the consultation diagrams. If this occurs NATS is to produce fresh maps using the new technology with the new data and the historic consultation data; this is to allow comparison of:

- The difference the between the old and new tools (i.e. compare consultation material with same data in new tool).
- The difference between the old and new data (i.e. comparing the consultation data and new data using the new tool).

If any of the sponsors find they are unable to produce directly comparable maps, they must advise the CAA at the earliest opportunity with a view to agreeing the best alternative presentation of data in advance of the PIR target deliverable date in May 2017.

Whilst airports have additional data that is not compatible with the NATS system, for example track plots distinguishing between RNAV and non RNAV arrivals, these should also be provided where relevant.

Where consultation and ACP material showed plots highlighting flights over AONBs, this is to be repeated for the PIR plots.

The Lmax data provided with consultation plots is to be reviewed and any difference highlighted.

Note 4: Sponsors are to review the assumptions of the CO2 analyses and update the analyses accordingly.

Note 5: Sponsors are to review all the ACP claims and report on whether the statements can be supported by observation post implementation.

Source Material	**Data Required**	**Remarks**	**Responsibility**	**Evidence**
Decision Documents				
CAP 1366 (Decision Document)	Not specified here; see Individual Modules, and ENV requirement under bridging Module			
General ENV Requirement for track dispersion plot diagrams	The general requirement for all Modules is that any diagrams provided as part of the PIR must be directly comparable with equivalent diagrams provided as part of the consultation and/or the proposal. There should be no changes to style, format, scale, colour-coding etc.	See note 3	NATS and airports	
Bridging Module 1	Updated CO_2 analysis using the same principles as the assessment undertaken as part of the Bridging Module. Assumptions to be updated based upon actual post-implementation data (e.g. the proportion of traffic that is tactically vectored, runway usage, flight numbers etc). Analysis to be broken down by Module, to reflect individually all five Modules submitted.	See note 4	NATS	See NATS reports: Bridge-Anticipated Impacts and Benefits Summary Bridge-Fuel-CO2-Analysis Bridge-Population-Overview-Analysis For MORs regarding overloads, see Bridge-Safety-Confidential-MORs

Source Material	**Data Required**	**Remarks**	**Responsibility**	**Evidence**
Module A **Decision Document** **STANSTED SID SWITCH**	Provide any details of occurrences of traffic using (U)M84 resulting in inadvertent penetration of D138A, together with action taken to prevent any further occurrence. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
Module A Operational A1	Provide details of any sector overload associated with the Stansted DET SID switch resulting in an MOR.	See note 2	NATS	No MORs were attributed to this scenario
A2	Provide details of any release difficulties to adjacent ACCs with traffic routeing through KONAN.	See note 2	NATS	See Bridging Module filename: Bridge-Safety-CONFIDENTIAL-MORs-LAMP-Related Specifically, report numbers 112535 & 113762
A3	Provide details of the number of flights using Stansted Rwy 22 and Rwy 04 CLN and DET SIDs for the period 4 Feb 15 – 3 Feb 16 and post change for period of 4 Feb 16 - 3 Feb 17. The number of flights post change should illustrate those flights specifically routeing eastbound after CLN on the original SID routeing, and those routeing via (U)M84 to KONAN.	To be provided from STAL records of departures	STAL for runway records	STAL has supplied their reports, see zip file A3-A4-A5-EnvA1_STAL-Reports KONAN data was supplied to STAL by NATS CPW and was also incorporated into evidence filename: A-Env2-Env4 Commentary

Source Material	Data Required	Remarks	Responsibility	Evidence
A4	Provide details of number of flights using the DET SID at night from 2300L-0600L for the periods in No 3 above.	To be provided from STAL records of departures	STAL for runway records NATS for flight plan data	STAL has supplied their reports, see zip file A3-A4-A5-EnvA1_STAL-Reports
A5	The sponsor should keep local reaction to the airspace change below 7000ft under review, and complete an annual summary of issues arising. Sponsors are requested to advise the CAA Airspace Regulation Consultation Regulator with an initial summary of any feedback by 30 June 2016.	STAL is to provide a summary of stakeholder reaction.	STAL	STAL has supplied their reports, see zip file A3-A4-A5-EnvA1_STAL-Reports NATS evidence supplied under Bridge-Comms-Complaints
Module A ENV A1	Sponsor to provide sufficient data to confirm that there have been no changes to Leq noise contours as a result of the airspace change, or alternatively to illustrate any changes to the contours. The sponsor may provide post-implementation contours for direct compassion with pre-implementation contours, or provide sufficient evidence that support any rationale that Leq contours are unchanged and do not need to be produced. Such evidence is likely to include a comparison of lateral and vertical aircraft tracks (both pre- and post-implementation).	If a rationale for not producing Leq contours cannot be provided and accepted by the CAA, then the comparison can be based on 2016 Leq contours – subject to other factors not related to the ACP being taken into account (e.g. traffic growth).	STAL	STAL has supplied their reports, see zip file A3-A4-A5-EnvA1_STAL-Reports

Source Material	Data Required	Remarks	Responsibility	Evidence
ENV A2	In addition to the requested operational track diagrams, the sponsor is to re-perform any noise assessment that was reflected in the consultation or proposal documents, to reflect post-implementation data. This includes any swathes, altitude bands, anticipated noise levels and frequency of flights that were used to portray the expected noise impact.	See Note 3.	NATS and airports are to review diagrams and assess/ provide what is required	Track plots complete, matching those in the main consultation doc (including consultation areas and AONB) See evidence folder A-Env2-Plots And filename A-Env2-Env4 Commentary
ENV A3	Sponsor to provide an assessment of the impact upon CO_2 emissions as a result of the airspace change, using the same methodology as the consultation and proposals, but updated as required using actual post-implementation data (e.g. to replace or update any assumptions used, to use actual track profiles and actual track mileages. The emissions assessment must be consistent with the pattern of traffic reflected in any associated track diagrams provided for the PIR.	See note 4.	NATS & Airport	See Bridging Module files: Bridge-Fuel-CO2-Analysis Bridge-Population-Overview-Analysis
ENV A4	Sponsor to provide sufficient data/rationale to support any claimed environmental impacts (positive, negative or neutral) made in consultation or proposal documents (e.g. Local Air Quality, tranquillity, visual intrusion etc.)	See note 5.	NATS and the airport are to review and assess what is required	Track plots from A-Env2 will be that evidence See filename A-Env2-Env4 Commentary

Source Material	Data Required	Remarks	Responsibility	Evidence
Module B **Decision Document** **LONDON CITY SID Replic** **Arr Trans Replic**	1. Requirement N/A here - detailed in Module C			
	2. Provide any details of occurrences when RNAV 1 traffic deviates from the RNAV1 flight path of the London City traffic downwind / base leg for Rwy 09 using the ODLEG arrival transition procedure resulting in an MOR to such an extent that controller intervention is required to maintain separation with the Heathrow Detling SIDs. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
	3. Provide any details of occurrences when RNAV1 traffic deviates from the RNAV1 flight path of the London City Rwy 27 RNAV SIDs resulting in an MOR to such an extent that controller intervention is required to maintain separation with the Heathrow Rwy 09 BPK SIDs. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
	4. Provide any details of occurrences when RNAV1 traffic deviates from the RNAV1 flightpath of the London City Rwy 27 RNAV SIDs resulting in an MOR to such an extent that controller intervention is required to maintain separation with the Heathrow Rwy 09 BUZAD SIDs. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
Module B Operational	Provide any details of any issues with flyability of all SIDs and Arrival Transitions. (Provide dates of any occurrences and	See note 2	NATS	None noted. See track plot packages B10 and B14 for examples of the impact

Source Material	Data Required	Remarks	Responsibility	Evidence
B1	appropriate details and how issues have been resolved).			of strong SW wind (Storm Imogen, 7-8 Feb 2016).
B2	Provide any details of EKNIV SIDs not being able to reach Min Stack Level by SODVU resulting in an MOR.	See note 2	NATS	No MORs were attributed to this scenario
B3	Provide details of any issues where the IFP naming and/or coding had an impact on the flyability of all SIDs.	See note 2	NATS	None noted
B4	Provide any details of issues associated with vectoring of non-RNAV 1 departures resulting in an MOR.	See note 2	NATS	No MORs were attributed to this scenario
B5	Provide any details of issues associated with vectoring of Rwy 09 non-RNAV 1 arrivals when turning aircraft onto base leg / final approach at TODBI resulting in an MOR.	See note 2	NATS	No MORs were attributed to this scenario
B6	Provide details of any issues with aircraft not being able to establish on the Rwy 09 ILS following the turn at ODLEG resulting in an MOR.	See note 2	NATS	No MORs were attributed to this scenario
B7	Provide any details of any inadvertent penetration of the London Heathrow CTR by traffic using the ODLEG arrival transition which fail to take the turn at TODBI resulting in an MOR and what subsequent action was taken.	See note 2	NATS	No MORs were attributed to this scenario

Source Material	Data Required	Remarks	Responsibility	Evidence
B8	Advise of RNAV 1 usage: 4 Feb 16, 4 May 16, 4 Aug 16, 4 Nov 16, 4 Feb 17	LAMP Sponsors are to provide quarterly updates as in Col 2.	LCAL	See evidence filename: B8 B9 B10 Data, Commentary
B9	The % of RNAV 1 / non-RNAV1 using each SID.	This is to be provided by analysing airport records of SID allocation.	LCAL	See evidence filename: B8 B9 B10 Data, Commentary
B10	The % of RNAV1 aircraft using the RNAV arrival transitions.	Flight plan data is to be analysed to identify flights filing on the transitions. NB: Track dispersion plots will need to show non-RNAV flights as well as RNAV	NATS for flight plan data	See evidence filenames: B8 B9 B10 Data, Commentary B10 B14 Commentary See folder of track plots: B10 Arrival transitions
B11	Any issues of RNAV1 traffic using the BPK/CPT SIDs not making the turn at LCN05 resulting in an MOR.	See note 2	NATS	No MORs were attributed to this scenario

Source Material	Data Required	Remarks	Responsibility	Evidence
B12	Details of any database coding issues and action taken to resolve.	See note 2	NATS	Coding issues arose on implementation that were not discovered during the live checks completed as per the CAA requirement to be carried out during the 10 days before the change. One airline operator discovered that the LAMP RNAV transitions had been linked to the STARs, but that their FMS could not cope with a “STAR followed by STAR”. The operator worked with the Coding Houses to rectify this and the problem was resolved in the first few weeks – the issue was raised immediately with the IFP team at CAA. The subject was raised through the LOCP (Lead Operator and Carrier Panel) meetings and its technical sub-group (attended by LAMP Case Officer) to highlight the required lessons learned for all parties. There was an instance of a coding house deciding to impose its own naming code for RNAV transitions to Biggin Hill, renaming the LAVNO and ODLEG transitions as JACKO and GODLU. This was flagged up in the live checking and coding houses advised accordingly to correct their charts. Again, the IFP team at CAA were advised of this. Following resolution of these issues during the first few weeks of implementation, there has been no recurrence of any associated problems.

Source Material	Data Required	Remarks	Responsibility	Evidence
B13	Any issues of inadvertent penetration of Southend CAS by traffic arriving into EGLC or departing from EGLC resulting in an MOR.	See note 2	NATS	No MORs were attributed to this scenario
B14	Monthly track dispersion plots of all London City conventional SIDs before the change are required for each SID, together with the new RNAV SIDs showing altitudes in 1000ft level bands on both conventional and RNAV track dispersion diagrams post change to illustrate monthly analysis carried out by London City Airport to determine whether the impacts on traffic patterns arising from the change have been as predicted as shown in consultation, both from an operational and environmental perspective. In particular, track keeping around the first turns should be monitored on a monthly basis to determine if the impacts are as portrayed in consultation. The track dispersion plots must be comparable with the diagrams shown in the consultation document to enable a direct like-for-like comparison. There must be explanation to illustrate when/where radar vectoring has occurred to enable stakeholders to understand any deviation away from the nominal track of the SID design that may be a result of radar vectoring as and where this occurs.	When providing RNAV track dispersion diagrams to illustrate RNAV impacts, please add suitable comments on diagrams to explain differentiation between the impacts of RNAV track dispersion and radar vectoring. Any track plots showing deviations away from the nominal track need to be explained, whether it is a result of 'direct to' instructions by ATC or tactical vectoring. Also, any unusual deviations away from the expected track arising from the effects of high winds, or otherwise, also need to be explained. If there are unusually high wind days, it is helpful from a flyability point of view to be able to show separately, impacts on these days. Action: LCAL		See evidence filename: B10 B14 Commentary See folder of track plots: B14 SIDs

Source Material	Data Required	Remarks	Responsibility	Evidence
	Track dispersion diagrams must illustrate the Rwy in use, SID designator and the number of aircraft in the relevant traffic sample to enable a like-for-like comparison between the conventional SIDs and RNAV SIDs. Details of the above monthly stats must be submitted to the CAA in the PIR data after 1 year of implementation. However, an initial first month snapshot is requested to provide an early indication of flight paths flown. Any changes in radar vectoring practices should be explained. Track dispersion data plots should be provided on separate diagrams to illustrate pre- airspace change track dispersion, and post airspace change track dispersion to illustrate both RNAV1 and non-RNAV1 traffic. (This is to enable explanation of differences between traffic patterns after the change).			
B15	The sponsor should keep local reaction to the airspace change below 7000ft under review,	LAMP sponsors are to provide a summary of stakeholder reaction.	LCAL and NATS as appropriate	See LCAL-supplied evidence items, filenames:

Source Material	Data Required	Remarks	Responsibility	Evidence
	and complete an annual summary of issues arising. Sponsors are requested to advise the CAA Airspace Regulation Consultation regulator with an initial summary of any feedback by 30 June 2016.			B15 LAMP Localised Complaints B15 Final Complaints Submission NATS evidence supplied under Bridge-Comms-Complaints
B16	Provide details of any level busts associated with the RNAV SID replications.	See note 2	NATS MM	No MORs were attributed to this scenario
Module B ENV B1	Sponsor to provide sufficient data to confirm that there have been no changes to Leq noise contours as a result of the airspace change, or alternatively to illustrate any changes to the contours. The sponsor may provide post-implementation contours for direct compassion with pre-implementation contours, or provide sufficient evidence that support any rationale that Leq contours are unchanged and do not need to be produced. Such evidence is likely to include a comparison of lateral and vertical aircraft tracks (both pre- and post-implementation).	If not producing Leqs state why.	LCAL to provide Leq contours or appropriate rationale if otherwise	See evidence filename: B-Env1-Leq Argument is that flights do not change path noticeably within the extent of the contour, therefore there would be no change to the contour itself due to the implementation of the RNAV1 flight procedures.
ENV B2	In addition to the requested operational track diagrams, the sponsor to re-perform any noise assessment that was reflected in the consultation or proposal documents, to reflect post-implementation data. This includes any swathes, altitude bands, anticipated noise	See note 3.	NATS and airport	Track plot data supplied for B10 & B14 will be that evidence. See evidence filenames: B10 B14 Commentary

Source Material	Data Required	Remarks	Responsibility	Evidence
	levels and frequency of flights that were used to portray the expected noise impact.			
ENV B3	Sponsor to provide an assessment of the impact upon CO_2 emissions as a result of the airspace change, using the same methodology as the consultation and proposals, but updated as required using actual post-implementation data (e.g. to replace or update any assumptions used, to use actual track profiles and actual track mileages. The emissions assessment must be consistent with the pattern of traffic reflected in any associated track diagrams provided for the PIR.	See note 4.	NATS and airport	See Bridging Module files: Bridge-Fuel-CO2-Analysis Bridge-Population-Overview-Analysis
ENV B4	Sponsor to provide sufficient data/rationale to support any claimed environmental impacts (positive, negative or neutral) made in consultation or proposal documents (e.g. Local Air Quality, tranquillity, visual intrusion etc.)	See note 5.	NATS and airport	Track plot data supplied for B10 and B14 will be that evidence. See evidence filenames: B10 B14 Commentary

Source Material	Data Required	Remarks	Responsibility	Evidence
Module C **Decision Document** LONDON CITY PM	1. Provide any details of occurrences of traffic using the GEGMU and GODLU STARs resulting in inadvertent penetration of D037 resulting in an MOR, together with action taken to prevent any further occurrence. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
	2. See note 2. Provide any details of occurrences of traffic using the GODLU Hold resulting in inadvertent penetration of the Paris FIR, together with action taken to prevent any further occurrence resulting in an MOR. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
	3. See note 2. Provide any details of occurrences of traffic using the ROPMU Hold leaving controlled airspace resulting in an MOR, together with action taken to prevent any further occurrence. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
	4. See note 2. Provide any details of occurrences of traffic in the ATPEV hold inadvertently entering the Shoeburyness Danger Areas resulting in an MOR, together with action taken to prevent any further occurrence. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
	5. See note 2. Provide any details of occurrences of traffic using the OKVAP Hold resulting in inadvertent penetration of the Paris FIR resulting in an MOR, together with	See note 2	NATS	No MORs were attributed to this scenario

Source Material	Data Required	Remarks	Responsibility	Evidence
	action taken to prevent any further occurrence. NIL returns required.			
	6. See note 2. Provide details of any flyability issues with aircraft using the arrival transition procedures between: JACKO-NONVA NONVA-BABKU ERKEK-OKVAP And the STAR between NEVIL-OSPOL.	See note 2	NATS	None known (see also B12)
	7. Review the climb and descent profiles of traffic utilisation in the lower limits of controlled airspace in the areas of controlled airspace identified in Module C Regulatory Requirement Serial 7 as discussed with NATS on 21 May 2015. NATS is to determine which areas of controlled airspace could be raised as a result of non usage by GAT, and provide appropriate draft AIP changes for the areas concerned. NATS is also to advise the CAA of any the options identified for potential raising of controlled airspace which are not feasible and provide the appropriate rationale.	**Action by 31 August 2016.** This date is required to enable the CAA to review and approve any proposals in order to meet the ICAO Southern England 1:500,000 chart due for publication on 2 March 2017. Note: the AIS deadline for chart amendments is 31 October 2016.	NATS	Closed in August 2016

Source Material	Data Required	Remarks	Responsibility	Evidence
	8. In conjunction with No 7 above, NATS is to determine whether the lower limits of the LTMA may be raised in LTMA Sectors 3 and 8 as follows: -- LTMA Sector 3 (3500-FL195) situated south of the Southend CTA 7 and, -- The revised LTMA Sector 8 from the north coast of Kent to the boundary of the LTMA Sector 21/N859 eastern extremity taking due consideration of the new southern arrival segment of the London City arrival transition procedure.	**Action by 31 August 2016** This date is required to enable the CAA to review and approve any proposals in order to meet the ICAO Southern England 1:500,000 chart due for publication on 2 March 2017. Notes: 1. The AIS deadline for chart amendments is 31 October 2016. 2. In conjunction with Module E	NATS	Closed in August 2016
Module C Operational C1	Provide any details of EKNIV SIDs not being able to reach MSL by SODVU.	See note 2	NATS	None noted. No MORs were attributed to this scenario
C2	Listed in Mod B.	Env Req		See Mod B
C3	Listed in Mod B.	See note 2	NATS	See Mod B
C4	Listed in Mod B.	See note 2	NATS	See Mod B
C5	Listed in Mod B.	See note 2	NATS	See Mod B

Source Material	Data Required	Remarks	Responsibility	Evidence
C6	Provide a summary of any unauthorised incursions into the new controlled airspace resulting in an MOR.	See note 2	NATS	None noted - No MORs were attributed to this scenario
C7	Provide details of any unusual holding patterns flown at the TIMBA RNAV hold. From an airline operational perspective, is the TIMBA RNAV hold being flown manually or via the FMS coding? Provide details of any issues which have impacted the FMS selection and/or flyability of the hold resulting in an MOR.	See note 2	NATS	None noted - No MORs were attributed to this scenario
C8	Provide details on any issues with the revised delegated ATS between LTC and Paris ACC in La Manche East Low.	See note 2	NATS	None noted - No MORs were attributed to this scenario
C9	Provide details of any issues with use of (U)L10 and the interface with Reims ACC.	See note 2	NATS	None noted - No MORs were attributed to this scenario
C10	Provide any details of excessive workload in vectoring non-RNAV 1 arrivals from either JACKO or GODLU inbound London City and Biggin Hill resulting in an MOR. (Nil returns required).	See note 2	NATS	None noted - No MORs were attributed to this scenario
C11	Provide track dispersion plot data of traffic in 1000ft level bands routeing from JACKO and GODLU to the LAVNO for Rwy 27 and ODLEG for Rwy 09 to illustrate the lowest levels flown.	See Note 3.	NATS and airports	See evidence filename: C11 Env-C1 Env-C2-Env-C4 Commentary See track plots folder: C11-PointMerge

Source Material	Data Required	Remarks	Responsibility	Evidence
C12	Provide details of any inadvertent entry into the Shoeburyness Danger Areas by traffic using the arrival transitions resulting in an MOR together with any subsequent action taken.	See note 2	NATS MM	No MORs were attributed to this scenario
C13	Provide details of the number of PAT alerts.	Determine with NATS how event data is gathered and processed, then confirm.	NATS to investigate available data	No PAT alerts resulted in safety incidents. See evidence filename: C13 PAT Alerts
C14	Details of any database coding issues that impacted ATC clearance delivery and/or operator selection of IFP and action taken to resolve.	See note 2	NATS MM	See item B12
C15	Are the Clearance Limit Points being monitored by ATC? Report any issues of where adherence of the clearance limit points on the STARs has not occurred resulting in an MOR.	See note 2	NATS MM	Clearance limit points are monitored by ATC. No MORs were attributed to this scenario
C16	The sponsor should keep local reaction to the airspace change below 7000ft under review, and complete an annual summary of issues arising. Sponsors are requested to advise the CAA Airspace Regulation Consultation Regulator	Early snapshot to consultation regulator by 30 April 2016.	NATS	NATS evidence supplied under Bridge-Comms-Complaints

Source Material	Data Required	Remarks	Responsibility	Evidence
	with an initial summary of any feedback by 30 June 2016.			
C17	Provide any details of occurrences of traffic failing to make the OSPOL waypoint when using the GODLU 1F and GEGMU 1G STARs due to the previous segment length resulting in an MOR. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
C18	Provide any details of occurrences of traffic failing to make the AVANT waypoint when using the GEGMU 1N STAR due to the previous segment length resulting in an MOR. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
C19	Provide any details of occurrences of traffic failing to make the OKVAP waypoint when using the GEGMU 1F STAR due to the previous segment length resulting in an MOR. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
C20	Provide any details of occurrences of traffic failing to make the ABTUM waypoint when using the TIMBA 1J/1K STARs due to the previous segment length resulting in an MOR. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
C21	Provide any details of occurrences of traffic failing to make the OSPOL waypoint when using the TIMBA 2G STAR due to the previous segment length resulting in an MOR. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario

Source Material	Data Required	Remarks	Responsibility	Evidence
C22	Provide any details of occurrences of traffic failing to make the EVEXU waypoint when using the SAM 2D STAR due to the previous segment length resulting in an MOR. NIL returns required.	See note 2	NATS	No MORs were attributed to this scenario
Module C ENV C1	In addition to the requested operational track diagrams, the sponsor to re-perform any noise assessment that was reflected in the consultation or proposal documents, to reflect post-implementation data. This includes any swathes, altitude bands, anticipated noise levels and frequency of flights that were used to portray the expected noise impact.	See note 3.	NATS & Airports	See evidence filename: C11 Env-C1 Env-C2-Env-C4 Commentary
ENV C2	Data regarding post-implementation traffic patterns over AONBs and National Parks to be provided, in order to support anticipated impacts set out in the consultation or proposal. Notably the following AONBs - Dedham Vale, Suffolk Coast & Heath, Kent Downs and High Weald.	See note 3.	NATS	See evidence filename: C-Env2-LC-AONB-Comparison-ArrsDeps
ENV C3	Sponsor to provide an assessment of the impact upon CO_2 emissions as a result of the airspace change, using the same methodology as the consultation and proposals, but updated as required using actual post-implementation data (e.g. to replace or update any assumptions used, to use actual track profiles and actual track mileages. The emissions assessment must be consistent with the pattern of traffic	See note 4.	NATS	See Bridging Module

Source Material	Data Required	Remarks	Responsibility	Evidence
	reflected in any associated track diagrams provided for the PIR.			
ENV C4	Sponsor to provide sufficient data/rationale to support any claimed environmental impacts (positive, negative or neutral) made in consultation or proposal documents (e.g. Local Air Quality, tranquillity, visual intrusion etc.)	See note 5.	NATS	See evidence filename: C11 Env-C1 Env-C2-Env-C4 Commentary

Module D **Decision Document Luton/ Northolt**	1. As per Module A 1.			
Module D Operational D1	Provide details of any sector overload associated with the Luton & Northolt DET SID switch resulting in an MOR.	See note 2	NATS	No issues noted – no MORs were specifically attributed to Luton/Northolt, for overload info see evidence filename Bridge-Safety-CONFIDENTIAL-MORs-LAMP-Related
D2	Provide the number of occasions when D138 is active above 13,000ft necessitating a re-route from M85 onto (U)M84 from 4 Feb 16-3 Feb 17.	NATS is to provide details of D138 activation but it is recognised that NATS may not be able to identify re-routes as a consequence; – NATS to investigate what is possible and provide detail as appropriate.	NATS	See evidence filename: D2-data-D138-use
D3	Provide number of flights regarding continued use of the DET SID for positioning flights or for traffic routeing via L10 to RINTI.	NATS is to produce a flight plan analysis.	NATS	See evidence filename: D3-data-D-Env2-D-Env3-commentary
Module D ENV D1	In addition to the requested operational track diagrams, the sponsor to re-perform any noise assessment that was reflected in the proposal documents, to reflect post-implementation data. This includes any swathes, altitude bands, anticipated noise levels and frequency of flights that were used to portray the expected noise impact.	See note 3.	NATS	Change occurred well along the track of the SIDs, generally FL100+, therefore no change to noise impacts below 7,000ft. This applies to both pre- and post-implementation.
ENV D2	Provide illustrations of vertical and lateral profiles that demonstrate traffic patterns between BPK and DET for departures from both Luton and Northolt. These should	See note 3 and 4.	NATS	See evidence filename: D3-data-D-Env2-D-Env3-commentary

	portray traffic patterns for comparative and representative periods, and should show a comparison between pre-implementation and post-implementation. Average tracks should be derived for both lateral and vertical profiles and then used to model the fuel burn and CO_2 emissions, and then extrapolated to estimate an annual figure for the respective fleets at each airport.			See Bridging Module files: Bridge-Fuel-CO2-Analysis
ENV D3	Provide data as evidence of the proportion of flights that benefit from the new routeing, i.e. the proportion of flights that achieve a profile that crosses above the Heathrow arrivals, both pre-implementation and post-implementation.	See note 3 and 4, this is to be achieved through the track plots analysis	NATS	Approx 32% of Luton DVR-bound deps moved from “below FL100” to “above FL150” which is above the majority of the Heathrow arrival flow in that area. See evidence filename: D3-data-D-Env2-D-Env3-commentary
ENV D4	Sponsor to provide an assessment of the impact upon CO_2 emissions as a result of the airspace change, using the same methodology as the proposals, but updated as required using actual post-implementation data (e.g. to replace or update any assumptions used, to use actual track profiles and actual track mileages. The emissions assessment must be consistent with the pattern of traffic reflected in any associated track diagrams provided for the PIR.	See note 4.	NATS	See Bridging Module files: Bridge-Fuel-CO2-Analysis
ENV D5	Sponsor to provide sufficient data/rationale to support any claimed environmental impacts (positive, negative or neutral) made in consultation or proposal documents (e.g. Local Air Quality, tranquillity, visual intrusion etc.)	See note 5.	NATS	None claimed

Module E **Decision Document** **Portsmouth CTAs, Southampton/ Bournemouth/ Farnborough arrivals.**	1. Provide any details of occurrences of traffic using the RUDMO Hold resulting in inadvertent penetration of D037 resulting in an MOR, together with action taken to prevent any further occurrence. NIL returns required.	See note 2	NATS	No issues noted – no MORs were attributed to this scenario
	As per Module C. 2. Review the climb and descent profiles of traffic utilisation in the lower limits of controlled airspace in the areas of controlled airspace identified in Module C Regulatory Requirement Serial 7 as discussed with NATS on 21 May 2015. NATS is to determine which areas of controlled airspace could be raised as a result of non usage by GAT, and provide appropriate draft AIP changes for the areas concerned. NATS is also to advise the CAA of any the options identified for potential raising of controlled airspace which are not feasible and provide the appropriate rationale.	**Action by 31 August 2016** This date is required to enable the CAA to review and approve any proposals in order to meet the ICAO Southern England 1:500,000 chart due for publication on 2 March 2017. Note: the AIS deadline for chart amendments is 31 October 2016.	NATS	Closed in August 2016

	As per Module C. 3. In conjunction with No 7 above, NATS is to determine whether the lower limits of the LTMA may be raised in LTMA Sectors 3 and 8 as follows: -- LTMA Sector 3 (3500-FL195) situated south of the Southend CTA 7 and, -- The revised LTMA Sector 8 from the north coast of Kent to the boundary of the LTMA Sector 21/N859 eastern extremity taking due consideration of the new southern arrival segment of the London City arrival transition procedure.	**Action by 31 August 2016** This date is required to enable the CAA to review and approve any proposals in order to meet the ICAO Southern England 1:500,000 chart due for publication on 2 March 2017. Notes: 1. The AIS deadline for chart amendments is 31 October 2016. 2. In conjunction with Module E	NATS	Closed in August 2016
	4. NATS is to investigate re-classification of the new Portsmouth CTAs 1 and 2 from Class A to Class C. Notwithstanding details provided to the CAA during the Case Study concerning reasons why NATS could not manage Class C operations immediately on implementation, NATS is to determine if these areas could be Class C rather than Class A as proposed. If a reversion to Class C is possible, NATS is to provide the CAA with a proposal to revert the Portsmouth CTAs to Class C airspace for implementation on 2 March 2017 meeting the appropriate AIRAC deadline for the AIP and ICAO 1:500,000 chart cycle (31 October 2017).	**Action by 31 August 2016** This date is required to enable the CAA to review and approve any proposals in order to meet the ICAO Southern England 1:500,000 chart due for publication on 2 March 2017. Note: the AIS deadline for chart amendments is 31 October 2016.	NATS	Closed in August 2016
	5. Provide a record of any instances where segregated VFR operations have been agreed in accordance with the Module E Regulatory Requirement No 5 together with		NATS	None recorded

	any issues arising and what action was taken to resolve the issue.			
Module E Operational E1	Provide track dispersion plot data of traffic in 1000ft level bands routeing through the Portsmouth CTA 1 & 2 to illustrate the lowest levels flown for traffic inbound to Farnborough, and inbound to Bournemouth and Southampton as far as the IAF for the runway in use. Track dispersion plots for flights before the change and flights after the change should demonstrate the new flight paths flown to enable comparison with diagrams shown in consultation. Compare with Consultation Document Fig D 5 and D 6 (both pre-change) and Figs D8 and D 9 (both post change) Data must be provided to illustrate a direct like-for-like traffic density for the changes below 7000ft before and after the change.	See note 3.	NATS	See evidence folder of track plots: E1-TrackPlots See evidence filename: E1-EnvE1-3-4-Track-Plot-Commentary
E2	Details of any database coding issues and action taken to resolve.	See note 2	NATS	None noted. No MORs were attributed to this scenario.
Module E ENV E1	In addition to the requested operational track diagrams, the sponsor to re-perform any noise assessment that was reflected in the consultation or proposal documents, to reflect post-implementation data. This includes any swathes, altitude bands, anticipated noise levels and frequency of flights that were used to portray the expected noise impact.	See note 3.	NATS	See evidence filename: E1-EnvE1-3-4-Track-Plot-Commentary

ENV E2	Sponsor to provide an assessment of the impact upon CO_2 emissions as a result of the airspace change, using the same methodology as the consultation and proposals, but updated as required using actual post-implementation data (e.g. to replace or update any assumptions used, to use actual track profiles and actual track mileages. The emissions assessment must be consistent with the pattern of traffic reflected in any associated track diagrams provided for the PIR.	See note 4.	NATS	See Bridging Module files: Bridge-Fuel-CO2-Analysis
ENV E3	Sponsor to provide sufficient data/rationale to support any claimed environmental impacts (positive, negative or neutral) made in consultation or proposal documents (e.g. Local Air Quality, tranquillity, visual intrusion etc.)	See note 5.	NATS	See evidence filename: E1-EnvE1-3-4-Track-Plot-Commentary
ENV E4	Data regarding post-implementation traffic patterns over AONBs and National Parks to be provided, in order to support anticipated impacts set out in the consultation or proposal, notably the Isle of Wight AONB.	See note 3.	NATS	See evidence filename: E1-EnvE1-3-4-Track-Plot-Commentary

Annex B - London City Airport Arrival and departure Track Analysis Assessment.

INTRODUCTION

1. To enable the CAA to conduct the PIR analysis, the sponsor provided traffic pattern plots for a five-day period of arrivals and departures in June 2013 and traffic samples throughout the first year of operation in 2016, which were taken from various five-day periods during February, May, August and November of 2016.

2. NATS provided a commentary **C01-C11** on the track dispersion for the network changes above 4000ft which covered the CAA requirement at C11, Env-C1, Env C2 and Env C4 to describe the impacts of the change. To understand this analysis it is recommended that readers first read the London Airspace Consultation Document Part E and Part F then the NATS commentary before reading this CAA analysis of the data provided. This CAA analysis should then be read in conjunction with viewing the relevant diagrams provided via links in the analysis Tables.This links will be completed as soon as possible after initial publication.

3. The CAA believes that these traffic patterns are consistent with the traffic patterns throughout the year as it covers all four seasons; therefore, for the purposes of this analysis, for arrivals, the February 2016 example is representative of the full samples although we have made comment on the May 2016 sample which shows extremely similar traffic patterns to February 2016. For departures, we have analysed the samples relating to February 2016 and then compared that sample with the remaining 3 samples taken through 2016. It should be noted that during February 2016, Storm Imogen created some very strong winds from the southwest. Impacts of this are also shown in the analysis.

4. In this assessment, we refer to a number of diagrams supplied by NATS. These are:

   Arrival procedures pre, and post change:

   - Density key diagram – this is similar to that for Module B and is attached. (e mail 26 Feb 18 refers).

- Track density plots for arrivals from 7000ft to touchdown for each runway.
- Track density plots for arrivals from 7000ft to touchdown for each runway with AONB superimposed.
- Track 'whisker plots' to show aircraft tracks in 1000ft band intervals from 10,000 to touchdown for each runway.
- C11 commentary showing arrivals from 7000ft to 4000ft with AONBs superimposed.

Departure procedures:

- C11 commentary showing departures from 4000ft to 7000ft with AONBs superimposed.
- Track density plots for departures with AONBs superimposed.

Note: The majority of the departure analysis is covered in Module B, however, the end segment analysis of the EKNIV SIDs has been copied to this analysis given the changes to that SID are above 4000ft and covered by the change in Module C.

ABBREVIATIONS/TERMINOLOGY

5. In this analysis, we refer to a number of technical aspects relating to the design of the arrival and departure procedures; to aid understanding, we have attempted to explain these terms in a non- technical manner:

DER	Departure End of Runway (normally the end of the physical length of the runway).
NM	Nautical mile.
WP (FO = flyover)	Waypoint (flyover means that the aircraft will fly over the position of the waypoint before turning to intercept the next segment of the procedure).
WP (FB = flyby)	Waypoint (flyby means that the aircraft will anticipate the turn before the waypoint to allow tangential interception of the next segment of the procedure).

Path Terminator — Is a set of defined codes, each of which defines a specific type of flight path and a specific type of termination of that flight path. Examples of these in the LCY Arrival and Departure Instrument Flight Procedures (IFPs) are course to fix (CF) and track to fix (TF).

6. The coding that is used within the Flight Management System (FMS) to capture the defined path and which is stored in the navigation data base is reflected through an Industry standard called ARINC Specification 424. The current version is ARINC 424-20, although earlier versions are still employed in many navigation data bases with varying functional capability. RNAV 1 defines a subset of functional blocks termed as 'Path Terminators' for use in the design of instrument flight procedures. In this way, all RNAV 1 qualified aircraft are capable of executing leg transitions and maintain tracks consistent with ARINC 424 path terminators. The required path terminators for RNAV 1 are:

- Initial Fix (IF)
- Track to Fix (TF)
- Course to Fix (CF)
- Course from a Fix to an Altitude (FA)
- Direct to a Fix (DF)
- Manual Termination (FM)

7. Although RNAV 1 defines the above Path Terminators, only a subset has been used in the designs for the London City RNAV 1 SIDs. Those used are described as follows:

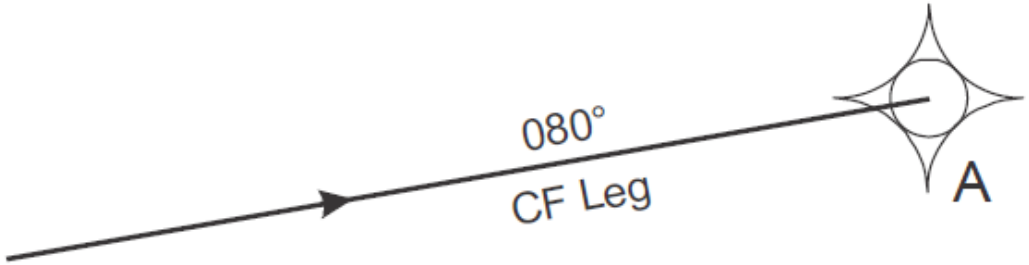
Track to Fix (TF)

A TF leg is defined as a geodesic path between two fixes (waypoints). It is the preferred leg type in RNAV Terminal Procedures that are not using ground based navaid references. The TF defines a great circle track over the ground between two known database fixes. The first fix is either the previous leg termination or an initial fix leg.

Track to Fix (TF) Leg

Path: Geodesic Path between A and B with Termination at Fix B

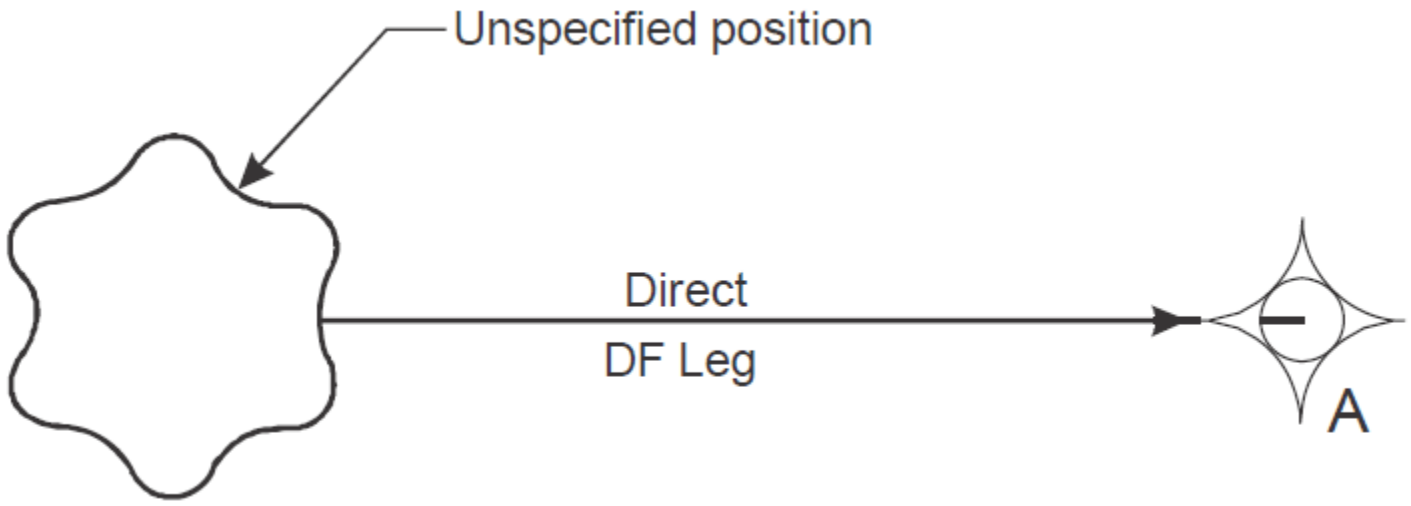
Course To Fix (CF) A CF leg is defined as a geodesic path that terminates at a fix with a specified course at that fix. The inbound course at the termination fix and the fix are provided by the navigation database.



Course to Fix (CF) Leg

Direct to a Fix (DF)

A DF leg defines an unspecified track starting from an undefined position to a defined fix. It is used to define a route segment from an unspecified position on the aircraft's present track to a specified fix or waypoint. A DF path terminator does not provide a predictable, repeatable flight path therefore it is effective in dispersing the flight tracks over the widest area. When a DF is used it ensures that the shortest track distance is flown from the unspecified position to the fix or waypoint.

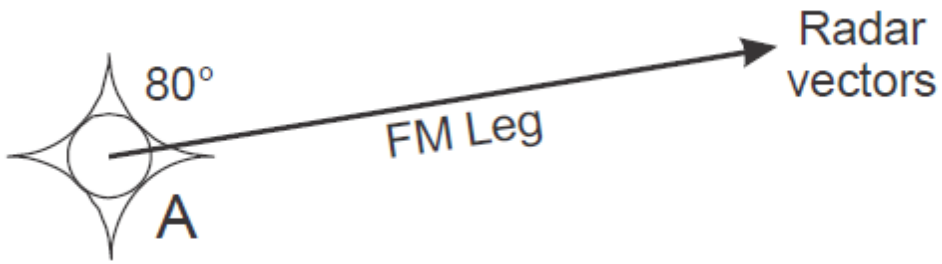


Direct to Fix (DF) Leg

Manual Termination

Course from a fix to a manual termination (FM)

An FM path terminator is used when a route segment is terminated for radar vectors. The aircraft continues on the prescribed heading until intervention by the pilot.



Course from a Fix to a Manual Termination (FM) Leg

Track Dispersion.

Is where the flights tracks over the ground of a procedure are varied due to the use of path terminator, differing aircraft types, operator standard operating procedures (SOPs) and wind conditions as examples. Track dispersion tends to spread the noise over a wider area.

Track Concentration.

Is where the tracks over the ground are concentrated on predictable flight tracks. Concentration of tracks can allow for noise sensitive areas to be avoided but it is not always possible to avoid all populated areas.

SID Nominal Track (NT).

The nominal track is the intended track to be flown when adhering to the speeds as shown on the procedure chart used by flight crews. The adherence to this published nominal track will vary in accordance with how the procedure has been designed to achieve either dispersion or concentration of flight tracks and external factors effecting aircraft ground speed e.g. wind conditions.

ILS

ILS s the abbreviation for the Instrument Landing System, which is the most commonly used precision approach aid in the world. It is known as a precision aid as it offers electronic guidance in both height in relation to the ideal approach path and also in azimuth in relation to the final approach track of the runway.

Airport / SID Designator: London City

Departures:	Runway 27:	BPK 1A, CPT 1A, CLN 1A, EKNIV 1A	Runway 09:	BPK 1H, CPT 1H, CLN 1H, EKNIV 1H
Arrivals:	Runway 27:	LAVNO 1J, LAVNO 1G	Runway 09:	ODLEG 1J, ODLEG1G

GUIDE TO INTERPRETING TRACK DISPERSION AND DENSITY DIAGRAMS

8. Attached to this document (via Links) are the track dispersion and density plots which have been provided by NATS to show the impacts of the airspace change.

9. To fully understand this review, readers will have to view (or be familiar with) the NATS consultation document Part E and Part F where the sponsor illustrated track dispersion diagrams before the change and consultation swathes where aircraft

would be positioned (subject to the feedback from consultation), the NATS ACP Bridging document and Module C airspace change proposal documents, and for the PIR itself, view the diagrams and data provided by the sponsor which are associated with the descriptions of track dispersion, track density and altitude band diagrams (where provided).

10. The explanations of track distribution are described using references to locations shown on the diagrams to help to describe impacts of the RNAV 1 arrival and departure procedures within the scope of the Module C network changes. The departures mainly focus on the new London City EKNIV SIDs for departures heading via EKNIV (approximately 5NM north of Detling) towards Lydd and points beyond to the south and west, and via EKNIV towards Dover for onward journeys to Europe. (most of this analysis is in Module B – to be re-checked)

11. The ADOBE PDF diagrams may be expanded using the plus or minus function in the Adobe toolset to see more detail of the mapping, and by use of the down or up arrows, it is possible to move to the next diagram or previous diagram to see the immediate difference between the track over the ground flown by aircraft before the change compared with track over the ground flown following the change. For comparison purposes, on some diagrams, it may be necessary to view the track distribution before and after the change with the 2013 and 2016 documents side by side on one computer screen and compare like for like samples – e.g. when viewing the arrival whisker plots, use the up and down arrows of the Adobe toolset to have an altitude band of the 2013 sample on the left of the screen and the same altitude band of the 2016 sample on the right of the screen – this will enable readers to see how the traffic patterns have noticeably changed in a number of regions which are affected by the London City procedures. Alternatively, the documents may be printed for comparison purposes.

TRACK DISPERSION DIAGRAMS

12. Track dispersion diagrams portray each aircraft track on a map, based on radar data. Tracks are overlaid upon each other, such that if many tracks are overlaid on top of each other, individual tracks may no longer be visible. They are useful for illustrating the dispersion of the traffic pattern, but are not as useful for determining the density/concentration of tracks.

TRACK DENSITY DIAGRAMS

13. Track density diagrams portray the concentration of flight tracks using a colour code to indicate differing concentrations of flight tracks. They are sometimes referred to as “heat plot” diagrams. Whilst they can be used to illustrate traffic dispersion, they are most useful for illustrating if traffic is concentrated along a route or over a geographic location. Depending on the

key used for portraying track concentration, individual tracks towards the outer limits of the dispersion may not be visible on the diagram.

TRAFFIC SAMPLES AND DIAGRAM INTERPRETATION

14. The traffic samples used for the PIR analysis reflect the sample portrayed in the consultation document in June 2013, followed by four samples during 2016 – February, May, August and November all of which are five day plots. Of note was Storm Imogen during February 2016 which had some impacts on operations during the period of 7-8 February, resulting in strong winds of 30kts with gusts of 45kts from the southwest.

    Note: In February 2016, a number of 'go-arounds' for arrival traffic when the crew has discontinued the approach to Runway 27 due to the effects of the wind on the final approach is apparent. This was described in the Module B analysis.

Consultation Diagrams Fig E8 (arrivals) and E9 (departures)

15. In the NATS London Airspace Consultation Part E Page E 24 paragraph 4.3 – 4.8 (reproduced below for ease of reference), the sponsor explained how to use maps and data to assess the potential effects of the change proposal. (CAA editorial edits for readability purposes in blue).

How to use the consultation maps and data to assess potential effects

4.3 NATS provided information to help answer the questions "Would the change mean more overflights? And if so how many aircraft and what is the potential effect?". This information is in the form of maps and data that indicate potential noise and visual impacts across a consultation swathe covering all the options for the positioning of the new PBN routes described in the document (it does not cover existing routes/flight paths that are not subject to change). The consultation swathes themselves are shown in the maps found in Figures E8 and E9, with data provided on the preceding page; additional

traffic data is also provided in Appendix H. Figures E8 and E9 may be directly compared to the map in Figure E2 which shows today's air traffic flows.

4.4 The noise and visual impact experienced at a given location will depend on where the route is positioned within the consultation swathe; high concentrations of traffic would be directly overhead only a small proportion of the overall area. NATS asked consultees to consider that the routes in

question could be positioned anywhere within the consultation swathe, and to be mindful therefore that anywhere within the consultation swathe has the potential for noise and visual impact.

4.5 Information on the scale of potential impact was presented; this information described:

- *The potential number of aircraft that would fly on the route and which may be overhead subject to the final route position within the consultation swathe; a summary was provided on the data page preceding each map and Appendix H provided further detail*
- *The altitude these aircraft would be[21]; this was shown by the shading on the maps themselves; this information was discussed in more detail in the paragraphs below*
- *A measurement of how loud aircraft at that height would sound at ground level (a metric referred to as Lmax) – this would also be dependent on the aircraft types expected; a summary was provided on the data page preceding each map with links to further detail*

[21] The maps show altitude which is height above mean sea level. Stakeholders should take account of the elevation of any area of interest when considering the maps and this data table. For example, if an area of interest is marked in the map beneath changes with minimum altitude of 5,000ft, but the ground level is 500ft, the actual minimum height the aircraft above would be is 4,500ft.

Altitude Data

4.6 The altitude information presented on the maps showed a worst-case altitude and an indication of typical altitude for aircraft during normal operations[22]. The worst case represented the lowest altitude NATS would normally expect an aircraft to be on the flight path in question. For example, the start of the 'minimum 4,000ft' altitude band on the map for the departure route is the area by which NATS would normally expect all aircraft to have reached 4,000ft. This would include the worst case of a slow climbing aircraft whose climb had been restricted by the presence of other aircraft above (such as the Heathrow arrivals described in Paragraph 2.17); a less restricted flight would climb earlier.

4.7 The typical altitude is shown to indicate that most aircraft will be significantly above the worst case; however, determining typical altitudes for aircraft across a wide swathe for a future airspace design is not an exact science. NATS has therefore erred on the side of caution with these typical values and so even they do not represent the true range of altitudes that aircraft may achieve. Additional maps showing the range of typical altitudes achieved today was provided in Appendix F; in general, NATS expected the proposed changes to mean that, for a given location, aircraft will be at the same or higher altitudes than shown today (i.e. before the change) in Appendix F.

4.8 Whilst this variation in altitudes would happen, it is difficult to represent in a consultation document; NATS therefore suggested that as a default, stakeholders should consider the potential impact of aircraft at the minimum altitude shown on Figures E8 and E9.

[22] Excluding any variation for safety reasons, or unusual circumstances such as extreme weather.

Density Plot Diagrams

16. Each diagram provided portrays a coloured density plot. The key to the density plots is the same as for Module B and is inserted into the data samples. This should be read before viewing the diagrams to enable readers to understand the varying traffic conditions. **B01**

GUIDE TO OUR ASSESSMENT OF THE LONDON CITY RNAV ARRIVAL PROCEDURES

17. In Table 1, we are showing our assessment of the new RNAV arrival procedures.

- Column 1 shows the arrival procedure and has the link to the relevant diagram.

- Column 2 describes the relevant segment of the arrival procedure, with an approximate geographical description together with the RNAV waypoints.

- Column 3 shows the design path terminator used in the design.

- Column 4 describes the traffic pattern before the change based on consultation material with the forecast description of what would change. The text in blue is the CAA description of the traffic patterns provided in the 2013 traffic sample.

- Column 5 is a qualitative description of the traffic pattern and track-keeping of the new arrival procedure and a comparison with radar vectoring before the change.

- Column 6 describes a vertical profile comparison of the new arrival procedure (traffic pattern) and comparison with radar vectoring before the change.

- Column 7 indicates whether the expected track-keeping has been achieved.

- Column 8 indicates whether the arrival procedure is being flown correctly by operators and whether the design is acceptable.

18. The CAA PIR analysis team has compared the impact of the new arrival procedures between 7000ft and 4000ft amsl with the traffic patterns achieved with radar vectoring before the change using the four traffic samples of 2016. In Table 1, we

indicate the characteristics of the RNAV track dispersion as a result of the RNAV designs and whether the anticipated impact has been realised.

19. For analysis purposes, we have divided the analysis of the track dispersion of the RNAV arrival procedures into segments. We are using approximate locations which are visible on the map to aid readers understand our analysis.

Runway 09: Segment 1 is to Dartford.

Runway 27: Segment 1 is to the London Gateway Port on the River Thames.

20. In Table 2 we show a comparative analysis of the impacts of the re-distribution of Runway 09 arrival traffic in altitude bands up to10,000ft amsl.

21. In Table 3 we show a comparative analysis of the impacts of the re-distribution of Runway 27 arrival traffic in altitude bands up to10,000ft amsl.

Table 1- Arrival Procedures Track Analysis

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
C15 C17 **Con Doc**	**Arrival and departure between 4000ft and 7000ft amsl**	**N/A**	**Consultation Document Fig E3 – London City & Biggin Hill flight paths** NATS showed the traffic patterns before the change; black arrow heads showed departure profiles and white arrow heads				

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
Part E			showed arrival profiles. AONBs were superimposed for reference. **LCY Design** The routes were then portrayed in the post consultation Feedback Design report: **Feedback Report V1 C 17**				
C15 Con Doc Part E Pages E29-30	**Arrival pattern between 4000ft and 7000ft amsl**		**Consultation Document Explanatory Notes for Fig E8** NATS explained that the final position of routes would be within the swathes shown in Page E 29 Fig E8 and provided details on the noise metrics concerning typical and noisiest aircraft.				
C15 Con Doc Part E Pages E29-30	**Arrival pattern between 4000ft and 7000ft amsl**		**Consultation Document Fig E8** **Consultation swathe arrivals 4-7000ft** The sponsor sought to position the arrival traffic pattern between 7000ft and 4000ft amsl anywhere in the swathe shown in the consultation document at Page E30 Figure E8.				
Runway 09 Arrivals							
C02 C 11 E Arr	**Segment 1** **From all directions to Dartford**		**Slide 1 Rwy 09 Sample June 2013** **Rwy 09 arrival tracks – diagram explanation**				

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
00-70 **Runway 09** **arrivals**			The resultant arrival track is superimposed onto Slide 4 where the point merge arrival tracks are shown from their originating points of JACKO in the Thames estuary to the northeast, and GODLU (just to the north of Dover) in the southeast. The principle being that aircraft follow the arrival tracks vertically separated from each other, and are then turned towards the merge point (RAVSA) as soon as they can be sequenced against each other. After RAVSA, they follow a predetermined flight path, or at any stage they may be given a more direct route towards position OSVEV to then position downwind to the south of London City airport.				
C02 **C 11 E Arr** **00-70** **Runway 09** **arrivals**	**Segment 1** **From all directions to Dartford** **For the RNAV1 arrival, this is LCS01**	**TF**	**Rwy 09 Sample June 2013** Prior to the change, before reaching Dartford to position downwind for the arrival to Runway 09, aircraft were radar vectored by ATC from different directions – from the north of the aerodrome and from many directions ranging clockwise all the way round to the south. **From the north,** aircraft were vectored from the Hoddesdon area (top left of diagram) towards Lambourne, then towards Romford/ Upminster, past Dagenham and then turned right to proceed 'downwind' right hand in the vicinity of Erith. When traffic conditions permitted, some aircraft (but not many) were vectored left hand downwind passing	**Slide 2 Rwy 09 Sample Feb 2016** With the introduction of the point merge arrival procedure, the arrival traffic pattern has very distinctly changed, as aircraft are now predominately following the RNAV point merge approach transition (the arrival procedure) from JACKO in the north east (top right of diagram) and from GODLU to the south east (bottom right in diagram). Whilst not evident in this picture, from these two positions, aircraft could either follow the point merge arcs and be turned in towards the merge point (RAVSA) which is in the middle of the Thames Estuary, or they could be routed direct to RAVSA and/or any further position along the arrival track in order to reduce the distance of the arrival pattern to keep the track mileage to the	The design is such that aircraft leave JACKO in the northeast at FL 90 and GODLU in the southeast at FL 100, and all aircraft must be cleared for descent to reach 6000ft by RAVSA, then maintain 6000ft to GAPGI, then descend to be at 4000ft by LCE07.	**Yes.** The traffic pattern is as expected. The objective of the design has been achieved.	**Yes** It would appear from the density plots that the majority of inbound flights are being vectored to OSVEV to some degree. From OSVEV to ODLEG, the transition as published in

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
			towards Wanstead and Walthamstow, before being turned towards onto a base leg in the vicinity of Finsbury Park and then on to final approach for landing. **From the northeast,** aircraft are vectored over Burnham-on-Crouch, over Southend airport (which is also where aircraft may be held in a holding pattern to sequence arriving traffic), after which they are vectored in a south westerly direction in a widespread traffic pattern from Canvey island stretching out towards Gillingham in the east to Dartford in the west. Anywhere between Gillingham and Dartford, they would join the inbound traffic flow from the southeast, east, and be radar vectored downwind to the south of London City airport. **From the south east**, aircraft are vectored from the Ashford area towards Detling, with a predominate flow towards Dartford (illustrated by the yellow concentration). However, a widespread traffic pattern is evident to the south and west of Rochester, where aircraft were often tactically vectored and held in tactical holding patterns for sequencing with traffic from the northeast and north, before they could be positioned to join the arrival flow towards Dartford and Chislehurst.	minimum when traffic conditions permit more direct routeings when aircraft do not have to be delayed behind other traffic in the arrival queue to land. This this can achieve an expeditious routeing of arriving aircraft. As this diagram shows traffic up to 7000ft, it is not possible to tell when direct routeing is being provided, however, it is obvious that more direct routeings are being provided to OSVEV which can be seen from the yellow and red concentration of the arriving aircraft. This it can be determine that the point merge arrival procedure is being used as it has been designed for, in that traffic follows the procedure until such time as ATC can give a more direct routeing to either RAVSA or OSVEV. The concentrated arrival track is more concentrated from just before aircraft reach RAVSA, then arrivals follow the procedure along the Estuary until such time as ATC can give the direct routeing to OSVEV – this is demonstrated by the more yellow and pink coloured concentrations of traffic from where aircraft are given the direct track to OSVEV at various points along the arrival track. Once aircraft reach OSVEV, they resume the arrival procedure to LCS 01 where they	After LCE07, aircraft descend to be at 3000ft by OSVEV. They then maintain 3000ft until LCS01, after which they descend to 2000ft.		the AIP is being flown as expected. Having checked the altitude details in the "Whisker Multi 2016-02(05, 08 & 11) -E Arrs" the altitude adherence is as expected.

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
				enter the traffic pattern below 4000ft, which is then covered by the analysis in Module B. The traffic pattern shown from RAVSA to OSVEV / LCS01 is representative of the expected flighpaths from the RNAV design and is also what we would expect to see from the design. With regard to the consultation swathe shown in consultation (Fig E8 – Slide 3), we would make the following observations: 1. The traffic pattern of the majority of arrivals are within the arrival swathe and are north of the southern extremity of the swathe diagram extending from Longfield (just south of position OSVEV) to Eastling where the swathe boundary changed towards the northeast towards Whitstable. 2. A very small number of aircraft were given a tactical delay to the southwest of Rochester which is in the area previously dominated by arrivals from the southeast; the track plot shows some aircraft to the south of the swathe. 3. To the north of the main westbound arrival track from RAVSA to LCE07, it is evident that some aircraft are being provided with a tactical routeing direct to OSVEV from either JACKO, NONVA or			

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
				BABGU. This represents some aircraft flying between Foulness and Southend overland on a similar track to where some arrivals flew before the change, and some aircraft flying over the sea southeast of the Essex coastline. It is presumed that these routeings are provided when the Shoeburyness danger area complex is not active.			
C02				**Slide 3 Rwy 09 Sample May 2016** Very similar to February 2016 sample, except for: 1. A few more direct routeings over Detling from the southeast. 2. A few more aircraft flying direct routeing to the north of the consultation swathe in the vicinity of Southend. 3. More concentration is evident before aircraft reach RAVSA, and from between GAPGI and ATPEV towards OSVEV. 4. The more direct routeings are most likely during quieter periods as highlighted in the NATS commentary (Slide 3). The traffic pattern shown from RAVSA to OSVEV / LCS01 is representative of the expected flightpaths from the RNAV design and is also what we would expect to see from the design.	**As above**	**Yes.** *The traffic pattern is as expected.* The objective of the design has been achieved.	**Yes** The transition as published in the AIP is being flown as expected. A lot of ATC vectoring can be seen occurring up to OSVEV.

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
C02				**Slide 4 Rwy 09 Sample August 2016** Very similar to May 2016 sample, except for: 1. More direct routeings over Detling. 2. More aircraft flying direct routeing to the north of the consultation swathe in the vicinity of Southend. 3. The more direct routeings are most likely during quieter periods as highlighted in the NATS commentary (Slide 3). The traffic pattern shown from RAVSA to OSVEV / LCS01 is representative of the expected flightpaths from the RNAV design and is also what we would expect to see from the design.	**As above**	**Yes.** The traffic pattern is as expected. The objective of the design has been achieved.	**Yes** The transition as published in the AIP is being flown as expected. A lot of ATC vectoring can be seen occurring up to OSVEV.
C02				**Slide 5 Rwy 09 Sample November 2016**	**As above**	**Yes.**	**Yes**

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
				Very similar to August 2016 sample. The more direct routeings are most likely during quieter periods as highlighted in the NATS commentary (Slide 3). The traffic pattern shown from RAVSA to OSVEV / LCS01 is representative of the expected flightpaths from the RNAV design and is also what we would expect to see from the design.		The traffic pattern is as expected. The objective of the design has been achieved.	The transition as published in the AIP is being flown as expected. A lot of ATC vectoring can be seen occurring up to OSVEV.
Runway 27 Arrivals							
C15 **C17** **Con Doc** **Part E**	**Arrival and departure between 4000ft and 7000ft amsl**	**N/A**	**Consultation Document Fig E3 – London City & Biggin Hill flight paths** NATS showed the traffic patterns before the change; black arrow heads showed departure profiles and white arrow heads showed arrival profiles. AONBs were superimposed for reference. The routes were then portrayed in the post consultation Feedback Design report:				

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
			Feedback Report V1 C 17				
C15 **Con Doc** **Part E** **Pages E29-30**	**Arrival pattern between 4000ft and 7000ft amsl**		**Consultation Document Explanatory Notes for Fig E8** NATS explained that the final position of routes would be within the swathes shown in Page E29 Fig E8 and provided details on the noise metrics concerning typical and noisiest aircraft.				
C15 **Con Doc** **Part E** **Pages E29-30**	**Arrival pattern between 4000ft and 7000ft amsl**		**Consultation Document Fig E8** **Consultation swathe arrivals 4-7000ft** The sponsor sought to position the arrival traffic pattern between 7000ft and 4000ft amsl anywhere in the swathe shown in the consultation document at Page E30 Figure E8.				
C08 **C 11 W Arr** **00-70** **Runway 27**	**Segment 1** **From all directions to the** London Gateway Port on the River		**Slide 1 Rwy 27 Sample June 2013** **Rwy 27 arrival tracks** The track density plot of the arrival traffic from 7000ft to touchdown is shown before the change. In this diagram, to illustrate the RNAV arrival flight path design, NATS has superimposed the point merge arrival tracks from their originating points of JACKO in the				

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
arrivals			Thames Estuary to the northeast, and GODLU (just to the north of Dover) in the southeast. The principle being that aircraft follow the respective arrival tracks vertically separated from each other, and are then turned towards the merge point (RAVSA) as soon as they can be sequenced against each other. After RAVSA, they follow the procedure to LAVNO after which aircraft establish on the ILS approach to land. After LANVO the remainder of this procedure is covered in the Module B analysis.				
C08 **C 11 W Arr** **00-70** **Runway 27** **arrivals**	**Segment 1** **From all directions to the** London Gateway Port on the River Point Merge arcs to LCE 07	**TF**	**Slide 1 Rwy 27 Sample June 2013** Prior to the change, it is evident that ATC have radar vectored aircraft from all directions to establish on the Runway 27 centreline by the M25 / A13 junction for the arrival to Runway 27. **From the north,** aircraft were vectored from the Hoddesdon area (top left of diagram) towards Lambourne, then managed in two distinctive traffic patterns; either via Dagenham towards Dartford and then turned towards the east before being turned back towards the aerodrome (thus involving delays and low level holding until they can be sequenced against other arriving traffic), or, they would be vectored to the east of Hornchurch and Upminster and then turned towards the airport to establish on the ILS by the M25. Some other aircraft have been	**Slide 2 Rwy 27 Sample Feb 2016** With the introduction of the point merge arrival procedure, the arrival traffic pattern has very distinctly changed, as aircraft are now predominately following the RNAV point merge approach transition (the arrival procedure) from JACKO in the north east (top right of diagram) and from GODLU (near Dover) to the south east (bottom right of diagram). Whilst not evident in this picture, from these two positions, aircraft could either be following the point merge arcs and be turned in towards the merge point (RAVSA) which is in the middle of the Thames Estuary, or they could be routed direct to RAVSA and/or any further position along the arrival track in order to reduce the distance of the arrival pattern to keep the track mileage to the minimum when traffic conditions permit more direct routeings when aircraft do not have to be delayed behind other traffic in the arrival queue to	The design is such that aircraft leave JACKO in the northeast at FL 90 and GODLU in the southeast at FL 100, and all aircraft must be cleared for descent to reach 6000ft by RAVSA, then maintain 6000ft to GAPGI, then descend to be at 4000ft by LCE07. After LCE07, aircraft descend	**Yes.** The traffic pattern is as expected. The objective of the design has been achieved	**Yes** The transition as published in the AIP is being flown as expected. A lot of ATC vectoring can be seen occurring up to TOPDU and LAVNO.

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
			vectored further to the east to join the arrival pattern from the Southend direction. **From the northeast,** aircraft are vectored over Burnham-on-Crouch, over Southend airport (which is also where aircraft may be held in a holding pattern to sequence arriving traffic), after which they are vectored in a south westerly direction in a widespread traffic pattern between Basildon and the Isle of Grain. Some aircraft are given a turn to establish on the ILS in the vicinity of the London Container Port, and others are given delays to the south of the Thames Estuary towards Rochester, before being turned back towards the airport. **From the south east**, aircraft are vectored from the Ashford area towards Detling, with a predominate flow towards Tilbury (illustrated by the yellow concentration). However, a widespread traffic pattern is evident to the south and west of Rochester, and additionally to the east of Rochester, where aircraft were often tactically vectored and held in tactical holding patterns for sequencing with traffic from the northeast and north, before they could be positioned to join the arrival flow towards Tilbury before establishing onto the runway centreline to commence the ILS approach to land on runway 27.	land. This can achieve an expeditious routeing of arriving aircraft. As this diagram only shows traffic up to 7000ft, it is not possible to tell when more direct routeing is being provided, however, it is obvious that the majority of arriving aircraft are being routed via RAVSA as there are 3 distinct concentrated flows just before aircraft reach RAVSA, although there are some direct routeings being provided to GAPGI, ATPEV, LCE07 and TOPDU, most likely occurring in quieter periods. Thus, it can be determined that the point merge arrival procedure is being used as it has been designed for, in that traffic follows the procedure until such time as ATC can give a direct routeing to RAVSA or points further west along the procedure. The concentrated arrival pattern is evident between RAVSA and LAVNO, although before the change, the pattern was concentrated after LCE07 (the London Gateway Port). Prior to LCE07 the new concentrated pattern is aligned along the Thames and the estuary. After LCE07, the traffic pattern is covered by the Module B change (and its analysis).	to be at 3000ft by LAVNO.		Having checked the altitude details in the "Whisker Multi 2016-02(05, 08 & 11) -W Arrs" the altitude adherence is as expected.

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
				The traffic pattern shown from the point merge arcs LCE07 is representative of the expected flightpaths from the RNAV design and is also what we would expect to see from the design. With regard to the consultation swathe shown in consultation (Fig E8 – Slide 3), we would make the following observations: 1. There is a traffic pattern to the north of the airport from Stratford to Hornchurch, followed by turns to the south at varying positions; this pattern relates to 'Go Arounds' which are also known as missed approaches. During the traffic sample period, aircraft were affected by Storm Imogen (strong winds). During this period, there were a significant number of 'go arounds' which are shown departing from runway 27 and being re-positioned by ATC towards the northeast so that they could be fed back into the arrival traffic flow. Go arounds are not an unusual event, however, they were more evident during the very strong winds in February 2016. 2. The traffic pattern of the majority of arrivals are along the Thames Estuary within the arrival swathe. 3. The tactical delaying manoeuvring techniques which were applied to aircraft			

Serial (1)	Segment / Stage / Phase of arrival procedure & Waypoints (2)	Path Terminator Employed (3)	Sponsor Consultation Document extracts: Traffic patterns before the change. Consultation swathe diagram - summary of location of proposed routes. In blue font, CAA description of traffic pattern before the change. (4)	Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring. (5)	Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring (6)	Track-keeping Achieved? (7)	Arrival procedure flown correctly by operators. If no provide details (8)
				over Kent at low level before the change are no longer evident. This is a result of the point merge design which was introduced to eliminate this delaying procedure and reduce controller workload. 4. To the north of the main westbound arrival track from RAVSA to LCE07, it is evident that some aircraft are being provided with a tactical routeing direct from the JACKO / BABGU area to GAPGI, ATPEV, LCE07 and TOPDU. This represents some aircraft flying between Foulness and Southend overland south of where arrivals from the northeast were routed before the change, and additionally some aircraft south of the Essex coastline towards Southend, then towards LCE07 on a similar track to where some arrivals flew before the change. It is presumed that these routeings are provided when the Shoeburyness danger area complex is not active.			
				Slide 4 Rwy 27 Sample August 2016 Very similar to May 2016 sample. The traffic pattern shown from the point merge arcs LCE07 is representative of the expected flightpaths from the RNAV design and is also what we would expect to see from the design.	**As above**	**Yes.** The traffic pattern is as expected. The objective of the design has been achieved.	**Yes** The transition as published in the AIP is being flown as expected. A lot of ATC vectoring can be seen

Serial **(1)**	**Segment / Stage / Phase of arrival procedure** **&** **Waypoints** **(2)**	**Path Terminator** **Employed** **(3)**	**Sponsor Consultation Document extracts:** **Traffic patterns before the change.** **Consultation swathe diagram - summary of location of proposed routes.** **In blue font, CAA description of traffic pattern before the change.** **(4)**	**Qualitative description of the track-keeping of the new RNAV arrival procedure (traffic pattern) & comparison with radar vectoring.** **(5)**	**Vertical Profile Description – comparison of new RNAV procedure compared with radar vectoring** **(6)**	**Track-keeping Achieved?** **(7)**	**Arrival procedure flown correctly by operators.** **If no provide details** **(8)**
							occurring up to TOPDU and LAVNO.
				Slide 5 Rwy 27Sample November 2016 Very similar to August 2016 sample. The traffic pattern shown from the point merge arcs LCE07 is representative of the expected flightpaths from the RNAV design and is also what we would expect to see from the design.	**As above**	**Yes.** The traffic pattern is as expected. The objective of the design has been achieved.	**Yes** The transition as published in the AIP is being flown as expected. A lot of ATC vectoring can be seen occurring up to TOPDU and LAVNO.

Table 2 - a comparative analysis of the impacts of the re-distribution of Runway 09 arriving traffic in altitude bands from 10,000ft to 3000ft amsl.

Altitude band (1)	Region of Traffic Flow (2)	Location of Traffic before the Change June 2013 (3)	Location of Traffic after the change February 2016 (4)	May 2016	Remarks (5)
100-090	North	Outside area shown on diagram.	North east of Clacton and over the sea.	Similar	
	North east	South of Clacton, Thames Estuary.	JACKO, south east of Clacton and over the sea.	Similar	
	South east	A few aircraft to Ashford.	Dover to Herne Bay, and centre of Thames Estuary (in the point merge procedure).	Similar	
090-080	North	A few aircraft towards Harlow.	JACKO and south east of Clacton over the sea, towards RAVSA.	Similar	
	North east	Between JACKO and Burnham on Crouch - mainly over the sea.	JACKO-BABGU-RAVSA over the sea.	Similar	
	South east	Some aircraft as far as Ashford and slightly beyond to the north west.	Dover-ELMIV / LCE12-RAVSA (majority over the sea).	Similar	
080-070	North	Most aircraft north west of Hoddesdon.	JACKO towards RAVSA / GAPGI over the sea.	Similar	
	North east	Between JACKO and Southend.	JACKO-BABGU-RAVSA / GAPGI over the sea.	Similar	
	South east	Most aircraft as far as Ashford with some slightly beyond to the north west to Lenham area.	Majority of aircraft north of Canterbury and Herne Bay and over the sea heading towards RAVSA and GAPGI.	Similar	

Altitude band (1)	Region of Traffic Flow (2)	Location of Traffic before the Change June 2013 (3)	Location of Traffic after the change February 2016 (4)	May 2016	Remarks (5)
070-060	North	Most aircraft north west of Lambourne.	Majority of aircraft between BABGU towards RAVSA / GAPGI over the sea, with direct routeings over Maplin Sands towards Southend, then ATPEV.	Similar	
	North east	Between JACKO and Southend.	Majority of aircraft between BABGU towards RAVSA / GAPGI over the sea, with direct routeings over Maplin Sands towards Southend, then ATPEV.	Similar	
	South east	Most aircraft as far as Detling.	Majority of aircraft well north of Whitstable and Herne Bay over the sea heading towards RAVSA and GAPGI.	Similar	
060-050	North	Majority of aircraft between Hertford and Lambourne, with a few aircraft further south towards Dagenham.	Majority of aircraft between BABGU and ATPEV over the sea, with some direct routeings over Maplin Sands towards Southend, then ATPEV. In this altitude band, aircraft come over land as the cross the coast around the Isle of Grain. Some aircraft are further west of ATPEV towards Gravesend.	Similar	
	North east	Between Foulness Sands as aircraft cross the coast, then aircraft fly over Southend and continue as far as East Tilbury.	Majority of aircraft between BABGU and ATPEV over the sea, with direct routeings over Maplin Sands towards Southend, then ATPEV. In this altitude band, aircraft come over land as they cross the coast around the Isle of Grain. Some aircraft are further west of ATPEV towards Gravesend.	Similar	
	South east	Most aircraft between Ashford and Detling.	Majority of aircraft from east of RAVSA towards ATPEV over the sea. In this altitude band, aircraft come over land as they cross the coast around the Isle of Grain with some further south crossing the coast over the Isle of Sheppey. Some aircraft are further west of ATPEV towards Gravesend.	Similar	

Altitude band (1)	Region of Traffic Flow (2)	Location of Traffic before the Change June 2013 (3)	Location of Traffic after the change February 2016 (4)	May 2016	Remarks (5)
050-040	North	Majority of aircraft between Hoddesdon and Dartford.	Majority of aircraft are between the Isle of Grain as they cross the coast over the Thames Estuary and then form a reducing 'arrowhead' pattern towards OSVEV before then proceeding downwind for Runway 09.	Similar	
	North east	After passing Burnham on Crouch, aircraft fly over Southend and then are directed such that they form a very widespread traffic pattern heading out towards Gillingham in the east and towards Dartford in the west.	Majority of aircraft are between the Isle of Grain as they cross the coast over the Thames Estuary and then form a reducing 'arrowhead' pattern towards OSVEV before then proceeding downwind for Runway 09.	Similar	
	South east	Most aircraft extend from Lenham towards Detling, then they are vectored in a widespread traffic pattern extending from Gillingham in the east towards Dartford in the west.	Majority of aircraft are between the Isle of Grain as they cross the coast over the Thames Estuary and then form a reducing 'arrowhead' pattern towards OSVEV before then proceeding downwind for Runway 09.	Similar	
040-030 Slight overlap with scope of Module B, but included for compl-etness.	North	Majority of aircraft between Epping and Dartford.	Majority of aircraft are between the Isle of Grain forming a reducing 'arrowhead' pattern towards OSVEV before then proceeding downwind towards Dartford for Runway 09.	Similar	
	North east	After passing Southend and Canvey Island, there is a widespread traffic pattern heading towards Dartford	Majority of aircraft are between the Isle of Grain forming a reducing 'arrowhead' pattern towards OSVEV before then proceeding downwind towards Dartford for Runway 09.	Similar	
	South east	Most aircraft extend from Detling and are vectored in a widespread traffic pattern towards Dartford.	Majority of aircraft are between the Isle of Grain forming a reducing 'arrowhead' pattern towards OSVEV before then	Similar	

Altitude band (1)	Region of Traffic Flow (2)	Location of Traffic before the Change June 2013 (3)	Location of Traffic after the change February 2016 (4)	May 2016	Remarks (5)
			proceeding downwind towards Dartford for Runway 09.		

Table 3 - a comparative analysis of the impacts of the re-distribution of Runway 27 arriving traffic in altitude bands from 10,000ft to 3000ft amsl.

Altitude band (1)	Region of Traffic Flow (2)	Location of Traffic before the Change June 2013 (3)	Location of Traffic after the change February 2016 (4)	May 2016 TBC	Remarks (5)
100-090	North	Outside area shown on diagram.	North east of Clacton and over the sea.	Similar	
	North east	South of Clacton, Thames Estuary.	JACKO, south east of Clacton and over the sea.	Similar	
	South east	Outside area shown on diagram.	Dover to Herne Bay, and centre of Thames Estuary (in the point merge procedure).	Similar	
090-080	North	A few aircraft towards Harlow.	JACKO and south east of Clacton over the sea, towards RAVSA.	Similar	
	North east	Between JACKO and Burnham on Crouch - mainly over the sea.	JACKO-BABGU-RAVSA over the sea.	Similar	
	South east	Some aircraft as far as Ashford and slightly beyond to the north west.	Dover-ELMIV / LCE12-RAVSA (majority over the sea).	Similar	

Altitude band (1)	Region of Traffic Flow (2)	Location of Traffic before the Change June 2013 (3)	Location of Traffic after the change February 2016 (4)	May 2016 TBC	Remarks (5)
080-070	North	Most aircraft north west of Hoddesdon.	JACKO towards RAVSA / GAPGI over the sea.	Similar	
	North east	Between JACKO and Southend.	JACKO-BABGU-RAVSA / GAPGI over the sea.	Similar	
	South east	Most aircraft as far as Ashford with some slightly beyond to the north west to Lenham area.	Majority of aircraft north of Canterbury and Herne Bay and over the sea heading towards RAVSA and GAPGI.	Similar	
070-060	North	Most aircraft north west of Lambourne.	Majority of aircraft between BABGU towards RAVSA / GAPGI over the sea, with direct routeings over Maplin Sands towards Southend, then ATPEV.	Similar	
	North east	Between JACKO and Southend.	Majority of aircraft between BABGU towards RAVSA / GAPGI over the sea, with direct routeings over Maplin Sands towards Southend, then ATPEV.	Similar	
	South east	Most aircraft as far as Detling.	Majority of aircraft well north of Whitstable and Herne Bay over the sea heading towards RAVSA and GAPGI.	Similar	
060-050	North	Majority of aircraft between Hertford and Lambourne, with a few aircraft further south towards Dagenham.	Majority of aircraft between BABGU and ATPEV over the sea, with some direct routeings over Maplin Sands towards Southend, then ATPEV. Aircraft are establishing on the runway centreline, in the main by RAVSA, but some are given a more direct routeing to ATPEV as they fly along the coast of Essex as they approach Southend.	Similar	

Altitude band (1)	Region of Traffic Flow (2)	Location of Traffic before the Change June 2013 (3)	Location of Traffic after the change February 2016 (4)	May 2016 TBC	Remarks (5)
	North east	Between Foulness Sands as aircraft cross the coast, then aircraft fly over Southend and continue as far as East Tilbury.	Majority of aircraft between BABGU and ATPEV over the sea, with some direct routeings over Maplin Sands towards Southend, then ATPEV. Aircraft are establishing on the runway centreline, in the main by RAVSA, but some are given a more direct routeing to ATPEV as they fly along the coast of Essex as they approach Southend.	Similar	
	South east	Most aircraft between Ashford and Detling.	Majority of aircraft from east of RAVSA towards ATPEV over the sea.	Similar	
050-040	North	Majority of aircraft between Hoddesdon and Dartford. Some aircraft are vectored towards Upminster for sequencing.	Majority of aircraft are between GAPGI and TOPDU on the arrival procedure flying over the sea as they approach the River Thames; they remain on the extended runway centreline for the approach to land on runway 27.	Similar	
	North east	After passing Burnham on Crouch, aircraft fly over Southend and then are directed such that they form a very widespread traffic pattern heading out towards Gillingham in the east and towards Dartford in the west.	Majority of aircraft are between GAPGI and TOPDU on the arrival procedure flying over the sea as they approach the River Thames; they remain on the extended runway centreline for the approach to land on runway 27.	Similar	
	South east	Most aircraft extend from Lenham towards Detling, then they are vectored in a widespread traffic pattern extending from Gillingham in the east towards Dartford in the west.	Majority of aircraft are between GAPGI and TOPDU on the arrival procedure flying over the sea as they approach the River Thames; they remain on the extended runway centreline for the approach to land on runway 27.	Similar	
040-030 Slight overlap	North	Majority of aircraft between Epping and Upminster are vectored to the east of Hornchurch and Upminster; a few aircraft are vectored towards Dartford	Majority of aircraft are between the Isle of Grain and LAVNO on the arrival procedure flying over the sea as they approach the River Thames; they remain on the	Similar	

Altitude band (1)	Region of Traffic Flow (2)	Location of Traffic before the Change June 2013 (3)	Location of Traffic after the change February 2016 (4)	May 2016 TBC	Remarks (5)
with scope of Module B, but included for compl-etness.		for repositioning and sequencing back into the arrival flow.	extended runway centreline for the approach to land on runway 27. There are a number of aircraft flying eastbound to the north of Hornchurch which are those aircraft which have executed a missed approach or 'go around' due to strong winds associated with Storm Imogen.		
	North east	After passing Southend and Canvey Island, there is a widespread traffic pattern as aircraft are vectored towards the runway centreline to intercept the ILS from the north for the final approach to Runway 27.	Majority of aircraft are between the Isle of Grain and LAVNO on the arrival procedure flying over the sea as they approach the River Thames; they remain on the extended runway centreline for the approach to land on runway 27. There are a number of aircraft flying eastbound to the north of Hornchurch which are those aircraft which have executed a missed approach or 'go around' due to strong winds associated with Storm Imogen.	Similar	
	South east	Most aircraft extend from Detling and are vectored in a widespread traffic pattern towards the runway centreline to intercept the ILS from the south for the final approach to Runway 27.	Majority of aircraft are between the Isle of Grain and LAVNO on the arrival procedure flying over the sea as they approach the River Thames; they remain on the extended runway centreline for the approach to land on runway 27. There are a number of aircraft flying eastbound to the north of Hornchurch which are those aircraft which have executed a missed approach or 'go around' due to strong winds associated with Storm Imogen.	Similar	

GUIDE TO OUR ASSESSMENT OF THE LONDON CITY RNAV-1 EKNIV DEPARTURE PROCEDURES ABOVE 4000ft

22. For completeness, this has been copied from the Module B track analysis report.

SID TRACK PLOTS

23. In Table 4, we are showing our assessment of the revised RNAV SID.

- Column 1 shows the departure procedure (and designator) and has the link to the relevant diagram.
- Column 2 describes the relevant segment of the SID design, with an approximate geographical description, together with the RNAV waypoints.
- Column 3 shows the design path terminator used in the design.
- Column 4 describes the traffic pattern before the change and the forecast traffic pattern (in blue) and whether dispersion or concentration was expected.
- Column 5 is a qualitative description of the traffic pattern and track-keeping of the new RNAV1 SID and a comparison with the conventional SID before the change.
- Column 6 describes a vertical profile comparison of the new SID and comparison with the conventional SID before the change.
- Column 7 indicates whether the expected track-keeping has been achieved.
- Column 8 indicates whether the arrival procedure is being flown correctly by operators and whether the design is acceptable.

EKNIV DEPARTURE PROCEDURES TRACK ANALYSIS

24. In Table 4 we show a departure analysis from above 4000ft. For analysis purposes, we have divided the analysis of the track dispersion of the modified RNAV SID design into a number of segments of segments; this is shown in Column 2 and varies depending on the SID design.

25. In Table 4 Column 7, the comparison is the basis on which we decide whether or not the RNAV SID has met its objective.

Table 4 – CAA Assessment of the London City EKNIV RNAV-1 SID above 4000ft

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
Rwy 09 EKNIV (cont) **B08** **B15** **B16** **B17** **B18**	**Segment 4** **LCE03-LCE06** **Upminster to Burstead Golf Course**		From Upminster (approx. location of LCE03), but also prior to reaching Upminster, there is a broad, dispersed swathe of tracks that travel eastwards across south Essex. Aircraft are further south than the waypoints for the new SID (LCE03, LCE06, SODVU). The forecast traffic pattern (based upon LCY Design Feedback Report) anticipated that from 4000ft and above: • Traffic would achieve an earlier climb; • Aircraft would track further east before turning south; • That based upon the procedure;	**Slide / Sample 2 - Feb 2016**. Evidence of concentration of tracks directly between LCE03 and LCE06. Some evidence of tactically vectored aircraft to the south of this concentration heading towards Basildon, but much less dispersion than the 2013 sample. No aircraft over south Essex (i.e. the area over which the 2013 traffic pattern was positioned). Some evidence of aircraft being vectored directly from LCE03 towards SODVU, rather than via LCE06. Note: these could also be Non-RNAV1 departures being radar vectored by ATC. Generally, aircraft are being kept on the SID for this segment.	2013 sample shows traffic is typically between 3000ft-6000ft for this segment, whereas in 2016 traffic is typically 4000-7000ft. However, in Slide B 21 00-70-200 Slide 2, some aircraft are at 7000ft and above in this altitude band at a position well before they reached 7000ft before the change	**Yes** Traffic pattern as expected in all 4 samples. The objective of the design has been achieved.	**Yes** The SID as published in the AIP is being flown as expected.

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
B19 **B20** **B21** **B22** **B23** **B24**			• design, traffic would generally avoid overflight of large towns such as Billericay, Wickford, Basildon and Rayleigh; • Aircraft would turn south (at SODVU) over Canvey Island but would typically be at 7000ft or above at that point; • Tactical vectoring would occur earlier than that location if aircraft had already achieved 7000ft.	**Slide / Sample 3 - May 2016.** Almost identical to Sample 2. **Slide / Sample 4 - Aug 2016.** Almost identical to Sample 2. **Slide / Sample 5 - Nov 2016.** Almost identical to Sample 2.	so there is a significant improvement in the climb profile Evidence that aircraft are achieving an improved climb profile.		
Rwy 09 EKNIV (cont) **B08** **B15**	**Segment 5** **LCE06-SODVU** **Burstead Golf Course to Rayleigh**		The broad swathe of traffic continues across south Essex, with evidence that most aircraft are being vectored south-eastwards when they are south abeam Basildon (though most aircraft are south of Basildon at this point rather than flying over it). Forecast Track Keeping as outlined in Segment 4 above.	**Slide / Sample 2 - Feb 2016**. Evidence of concentration of tracks directly between LCE06 and SODVU, but fewer aircraft than segment 4 as aircraft climb beyond 7000ft. LCE06. Some evidence of tactically vectored aircraft to the south of this	2013 sample shows traffic is typically between 3000ft-7000ft for this segment, whereas in 2016 traffic is typically 5000-7000ft, with most tracks disappearing well before SODVU.	**Yes** Traffic pattern as expected in all 4 samples. The objective of the design has been achieved	**Yes** The SID as published in the AIP is being flown as expected.

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
B16 B17 B18 B19 B20 B21 B22 B23 B24				concentration heading towards Basildon, but much less dispersion than the 2013 sample. No aircraft over south Essex (i.e. the area over which the 2013 traffic pattern was positioned). Note: these could also be Non-RNAV1 departures being radar vectored by ATC. Some evidence of a few aircraft below 7000ft being vectored directly from LCE03 towards SODVU, rather than via LCE06. Note: these could also be Non-RNAV1 departures being radar vectored by ATC. Generally, aircraft are being kept on the SID for this segment. **Slide / Sample 3 - May 2016.** Almost identical to Sample 2. **Slide / Sample 4 - Aug 2016.** Almost identical to Sample 2.	However, in Slide B 21 00-70-200 Slide 2, some aircraft are at 7000ft and above in this altitude band at a position well before they reached 7000ft before the change so there is a significant improvement in the climb profile Evidence that aircraft are achieving an improved climb profile.		

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
				Slide / Sample 5 - Nov 2016. Almost identical to Sample 2.			
Rwy 09 EKNIV **(cont)** **B08** **B15** **B16** **B17** **B18** **B19** **B20**	**Segment 6** **SODVU-EKNIV** **Rayleigh to the River Medway Estuary**		Very wide swathe of dispersed tracks continues south-eastwards over Canvey Island. Forecast Track Keeping as outlined in Segment 4 above.	**Slide / Sample 2 - Feb 2016**. Almost no aircraft tracks beyond SODVU, which indicates that almost all aircraft have achieved 7000ft by this point. **Slide / Sample 3 - May 2016.** Almost identical to Sample 2. **Slide / Sample 4 - Aug 2016.** Almost identical to Sample 2. **Slide / Sample 5 - Nov 2016.** Almost identical to Sample 2.	2013 sample shows traffic is typically between 3000ft-7000ft for this segment with tracks beyond SODVU, whereas in 2016 traffic almost all above 7000ft before SODVU, with a few tracks at 6000ft-7000ft. Evidence that aircraft are achieving an improved climb profile.	**Yes** Traffic pattern as expected in all 4 samples. The objective of the design has been achieved	**Yes** The SID as published in the AIP is being flown as expected.

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
B21 **B22** **B23** **B24**							
Runway 27 Departures							
Rwy 27 EKNIV (cont) **B13** **B30** **B31**	**Segment 4** **WP3-WP4** **LCN06-LCE06**		From Harold Hill (approx. location of LCN06), but also prior to reaching Harold Hill, there is a broad, dispersed swathe of tracks that travel eastwards across Hornchurch and south Essex. Aircraft are further south than the waypoints for the new SID (LCN06, LCE06, SODVU).	**Slide / Sample 2 - Feb 2016**. Evidence of concentration of tracks directly between LCN06 and LCE06. Some evidence of tactical vectored aircraft to the south of this concentration heading towards Basildon, but much less dispersion than the 2013 sample. No aircraft over south Essex (i.e. the area over which the 2013 traffic pattern was positioned). Note: These may be Non-RNAV 1 departures which are vectored by ATC.	2013 sample shows traffic is typically between 2000ft-6000ft for this segment, whereas in 2016 traffic is typically 3000-7000ft. However, in Slide B 31-34 00-70-200 Slide 2, some aircraft are at 7000ft and above in this	**Yes** Traffic pattern as expected in all 4 samples. The objective of the design has been achieved.	**Yes** The SID as published in the AIP is being flown as expected.

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
B32 **B33** **B34**			The forecast traffic pattern (based upon LCY Design Feedback Report) anticipated that from 4000ft and above: • Traffic would achieve an earlier climb; • Aircraft would track further east before turning south; • That based upon the procedure; • design, traffic would generally avoid overflight of large towns such as Billericay, Wickford, Basildon and Rayleigh; • Aircraft would turn south (at SODVU) over Canvey Island but would typically be at 7000ft or above at that point; 1. Tactical vectoring would occur earlier than that location if aircraft had already achieved 7000ft.	Some evidence of aircraft being vectored directly from LCN03 towards SODVU, rather than via LCE06. Note: These may be Non-RNAV 1 departures which are vectored by ATC. Generally, aircraft are being kept on the SID for this segment. **Slide / Sample 3 - May 2016.** Almost identical to Sample 2. **Slide / Sample 4 - Aug 2016.** Almost identical to Sample 2. **Slide / Sample 5 - Nov 2016.** Almost identical to Sample 2.	altitude band at a position well before they reached 7000ft before the change so there is a significant improvement in the climb profile Evidence that aircraft are achieving an improved climb profile.		

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
Rwy 27 EKNIV (cont) **B13** **B30** **B31** **B32** **B33** **B34**	**Segment 5** **WP4-WP5** **LCE06-SODVU**		The broad swathe of traffic continues across south Essex, with evidence that most aircraft are being vectored south-eastwards when they are abeam Basildon (though most aircraft are south of Basildon at this point rather than flying over it). Forecast Track Keeping as outlined in Segment 4 above.	**Slide / Sample 2 - Feb 2016**. Evidence of concentration of tracks directly between LCE06 and SODVU, but fewer aircraft than segment 4 as aircraft climb beyond 7000ft. LCE06. Some evidence of tactical vectored aircraft to the south of this concentration heading towards Basildon, but much less dispersion than the 2013 sample. No aircraft over south Essex (i.e. the area over which the 2013 traffic pattern was positioned). Some evidence of a few aircraft below 7000ft being vectored directly from LCN03 towards SODVU, rather than via LCE06. Note: These may be Non-RNAV 1 departures which are vectored by ATC. Generally, aircraft are being kept on the SID for this segment. **Slide / Sample 3 - May 2016.**	2013 sample shows traffic is typically between 3000ft-7000ft for this segment, whereas in 2016 traffic is typically 4000-7000ft, with most tracks disappearing well before SODVU. However, in Slide B 31-34 00-70-200 Slide 2, some aircraft are at 7000ft and above in this altitude band at a position well before they reached 7000ft before the change so there is a significant improvement in the climb profile Evidence that aircraft are	**Yes** Traffic pattern as expected in all 4 samples. The objective of the design has been achieved	**Yes** The SID as published in the AIP is being flown as expected.

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
				Almost identical to Sample 2. **Slide / Sample 4 - Aug 2016.** Almost identical to Sample 2. **Slide / Sample 5 - Nov 2016.** Almost identical to Sample 2.	achieving an improved climb profile.		
Rwy 27 EKNIV **(cont)** **B13** **B30** **B31**	**Segment 6** **WP5-WP6** **SODVU-EKNIV**		Very wide swathe of dispersed tracks continues south-eastwards over Canvey Island. Forecast Track Keeping as outlined in Segment 4 above.	**Slide / Sample 2 - Feb 2016**. Almost no aircraft tracks beyond SODVU, which indicates that almost all aircraft have achieved 7000ft by this point. **Slide / Sample 3 - May 2016.** Almost identical to Sample 2.	2013 sample shows traffic is typically between 4000ft-7000ft for this segment with tracks beyond SODVU, whereas in 2016 traffic almost all above 7000ft before SODVU, with a few tracks at 6000ft-7000ft.	**Yes** Traffic pattern as expected in all 4 samples. The objective of the design has been achieved	

Serial (1)	Segment / Stage / Phase of SID & Waypoint (2)	Path Terminator Employed (3)	Traffic pattern before the change and Forecast Track Keeping Performance (Dispersion or Concentration) [this is a description of what the sponsor expected the traffic pattern to be]. (4)	Qualitative description of the track-keeping of the new RNAV SID (traffic pattern) & comparison with conventional SID. (5)	Vertical Profile Description – comparison of new RNAV SID with conventional SID. (6)	Track-keeping Achieved? (7)	SID Flown Correctly by Operators If no provide details SID Technical Design Acceptable (Yes/No) (8)
B32 **B33** **B34**				**Slide / Sample 4 - Aug 2016.** Almost identical to Sample 2. **Slide / Sample 5 - Nov 2016.** Almost identical to Sample 2.	However, in Slide B 31-34 00-70-200 Slide 2, some aircraft are at 7000ft and above in this altitude band at a position well before they reached 7000ft before the change so there is a significant improvement in the climb profile Evidence that aircraft are achieving an improved climb profile.		

Annex C - "LAMP PIR Bridging Module Analysis – Changes to population overflown by Modules A, B and C" (Version 2)

NATS has prepared an assessment of population "overflown" in support of the PIR. This focuses on the population overflown below 7,000ft.

Commentary on the specific results for Modules A, B & C are contained within the body of each respective PIR Report from the CAA. The commentary below is general and highlights points regarding the methodology used by the sponsor.

1. NATS has used two approaches to assess the population overflown:
- The first is a simple boundary that closely encompasses the concentrated traffic pattern below 7,000ft and a count of the population within that boundary. As a measure, this could be taken to show the population that is directly overflown on a regular basis (which NATS has defined as more than five flights per day);
- The second is a simple approximation of the methodology set out in the CAA's document CAP1498[7]. The precise approach that is outlined in that document as not been used; NATS has not produced "overflight" contours that would enable a better understanding of extent to which locations are overflown, nor have they used the widening swathe that represents aircraft as they climb or descend. Instead they have used a standard swathe of 1,079m for aircraft up to 4,000ft and a swathe of 1,888m for aircraft between 4,000ft and 7,000ft. Using this simplified methodology has the potential to not only over-estimate the area being "overflown" but also does not reflect the frequency of being overflown, i.e. the population count in these swathes does not differentiate between people overflown rarely and those overflown frequently.

2. This impact was not measured or portrayed by the sponsors as part of the consultation material or the formal submission of the LAMP modules; CAP1498 did not exist at the time of the original consultation and submission by the sponsor, or the decision by the CAA. These impacts are being measured and portrayed for the first time as part of the PIR. Therefore, if we use the impacts now being presented in the PIR, we need to be aware that this method for estimating and portraying "overflights" was not part of our consideration when approving the original Airspace Change Proposals.

[7] CAP1498: "Definition of overflight", April 2017

Annex D - CO_2 Emissions Summary

Comparing forecast CO_2 impact from the original Airspace Change Proposal (ACP) documents with the Post-Implementation Review (PIR) outputs

	Forecast for 2016 (per original ACP)				PIR Results	
ACP Module	**Base case annual "enabled" fuel saving (tonnes)**	**Base case annual "actual" fuel saving (tonnes) – reduction of 21%**	**Convert to CO_2 @ 3.18 (tonnes)**	**Range for CO_2 annual saving per ACP - i.e. 50% as low case (tonnes)**	**NATS Report (A17035, V1.0) – fuel saving (tonnes)**	**Convert to CO_2 @ 3.18 (tonnes)**
Module A - Stansted	4,298	3,395	10,796	5,398 - 10,796	3,557	11,311
Module B – London City Replications	0[8]	0	0	0	0	0
Module C – London City Network (plus Gatwick & Southend)	LCY = 4,082 Gatwick (TIMBA STARs) & Southend = 3,959 **Total = 8,041**[7] (no separate figures for Biggin Hill)	6,352	20,199	10,099 - 20,199	LCY = -3,779 Gatwick = 178 Southend = - 81	-11,709
Module D – Luton & Northolt	1,815	1,434	4,560	2,280 - 4,560	Luton = 678 Northolt = -1	2,153
Module E – South Coast (Farnborough, Southampton, Bournemouth)	-265	-209	-665	-332 - -665	Farnborough = -89 Southampton = -48 Bournemouth = -8	-461
Total	**13,889**	**10,972**	**34,890**	**17,445 – 34,890**	**407**	**1,294**

[8] The CO_2 impacts from London City that were reported in the Bridging ACP did not distinguish between those from the Replications (Module B) or the Network (Module C) and so the entire figure for London City was reflected in this table as being Module C.

Conclusion:

The key difference in impact between the ACP and the PIR (as shown in the table above) is for Modules B & C (i.e. the changes at London City airport). An overall fuel saving and CO_2 reduction was estimated at the time of the proposal – instead the PIR shows a significant increase in fuel and CO_2, most notably for the arrivals. For the other modules (A, D & E) the changes in CO_2 impacts are broadly consistent with the estimated ranges that were considered when the CAA decision to approve was taken.

Notes:

- It should be recognised that the original estimate submitted with the ACP, as with all such CO_2 estimates, has to make various assumptions when modelling the most likely changes to fuel burn and emissions. By their nature, they include a degree of uncertainty.
- The original ACP estimate (doc 44165/RPT/144, V1.2) did specifically adjust for tactical vectoring. (For example, read the statement made in the Introduction of that document about adjusting for tactical interventions in order to reflect "actual" flight trajectories. Equally the explanation of the adjustments made in Section 6 of that document to reflect "actual" fuel burn). However, what it did not do was make any assumptions about possible changes to the rate/proportion of tactical vectoring that would occur after implementation.
- The original CO_2 analysis for the ACP modelled two years, 2016 and 2020.
- Original ACP – the fuel burn and CO_2 estimates for London City routes did reflect the sponsor's expectations of an increase in track mileage generally, but also balanced this against expected savings in holding time and improved vertical profiles for arriving aircraft. The result was that fuel savings and CO_2 reductions were forecast for London City flights.
- The analysis excludes traffic from 4 Feb 2016 to 29 Feb 2016 because it was a period of "bedding-in" for the change. It includes traffic from 1 March 2016 to 3 Feb 2017. However, the number of movements for the full year has been used when calculating an annual total.
- The PIR assessment adjusts for fleet mix to ensure it is consistent, so that the changes in fuel burn and CO_2 are not a reflection of a change in relative proportions of aircraft types.
- The anticipated number of affected arrivals in the ACP for implementation year was 116,742. In the PIR analysis the number of arrivals is actually 122,129.
- The anticipated number of affected departures in the ACP for the implementation year was 56,839. In the PIR analysis the number of departures is actually 64,715.

Annex E - Presentation to NATMAC on controlled airspace lower limit revision

Civil Aviation Authority

LAMP PHASE 1A INITIAL PIR – LOWER LIMITS OF CAS REVIEW

NATMAC 80

Civil Aviation Authority

27 October 2016

LAMP PHASE 1A – INITIAL PIR – LOWER LIMITS OF CAS REVIEW

- Outcome of CAA review of NATS analysis 31 Aug 16:
- Some lower limits could be raised
- Very small window of opportunity for implementation on 2 Mar 17
  - Needs decision by 1 Nov 16 otherwise 1 year delay.
- Objectives:
  - Raise CAS if not required
  - Simplify airspace structures where possible
  - Reduce chart / label clutter
  - Reduce risk of infringements
  - Opportunity to smooth out a few lateral boundaries

LAMP PHASE 1A – INITIAL PIR – LOWER LIMITS OF CAS REVIEW – NATMAC FEEDBACK AS AT COP 26 OCT 16

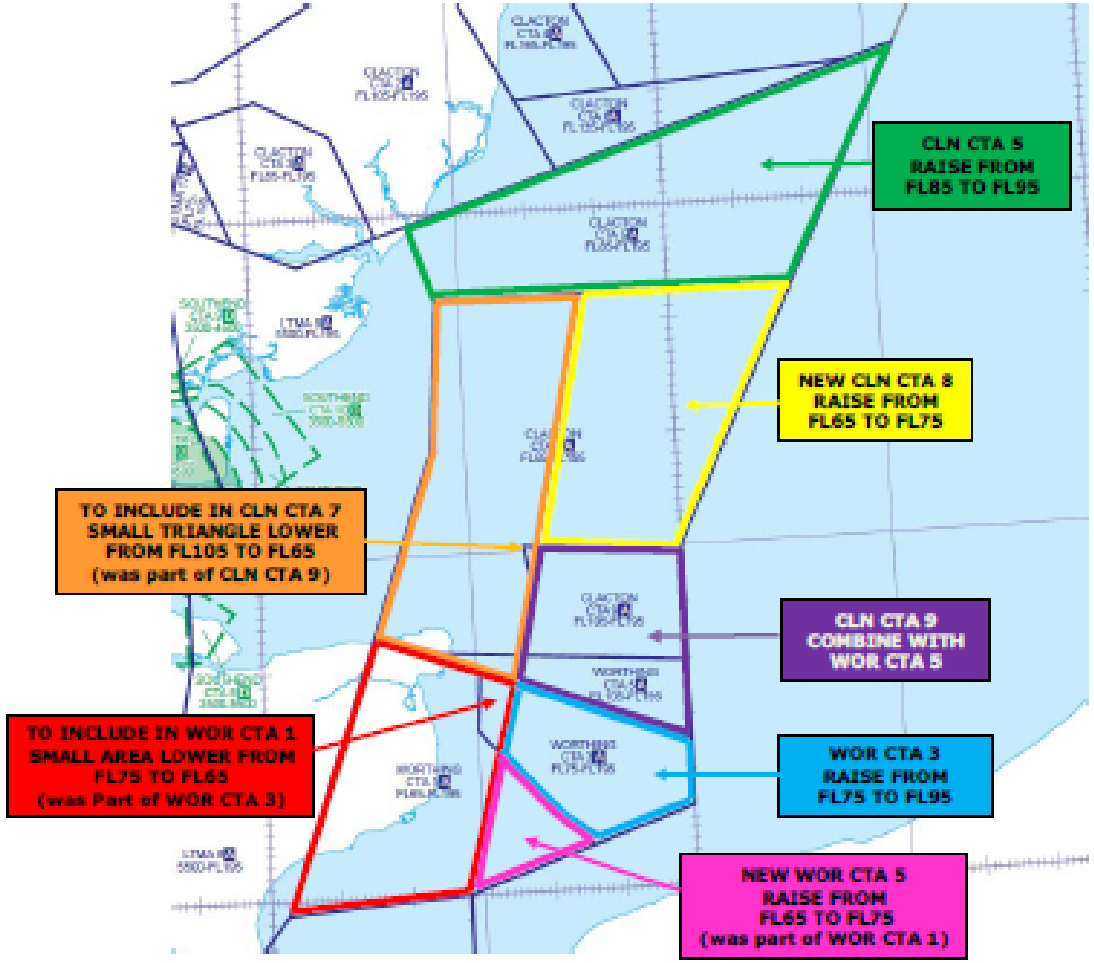
- 7 responses to date:
- 5 responses supported proposals but with some caveats:
  - Consider raising LTMA 14 to 5500ft – CAA comment - not possible
  - Pressurisation & icing issues; due time constraints, consider only raising up to FL 80 in short term until further analysis conducted – this allows for non-pressurised operations and caters for potential icing – CAA comment – see following slide for possible option
- One query raised - formal response pending
- NATS supplied a further option (3a) for south coast - still being considered by NATS:
  - Would raise only the southern part of WOR CTA 2 up to FL85 and
  - Would raise WOR CTA 6 up to FL85

  – CAA comments – would now initially discount both options given pressurisation and icing issues – hence leave at FL75. Could just consider the minor adjustment to the WOR CTA 7 & 4 common boundary (over the sea)

ATTACHMENT A TO NATMAC LETTER DATED 13 OCTOBER 2016

Civil Aviation Authority

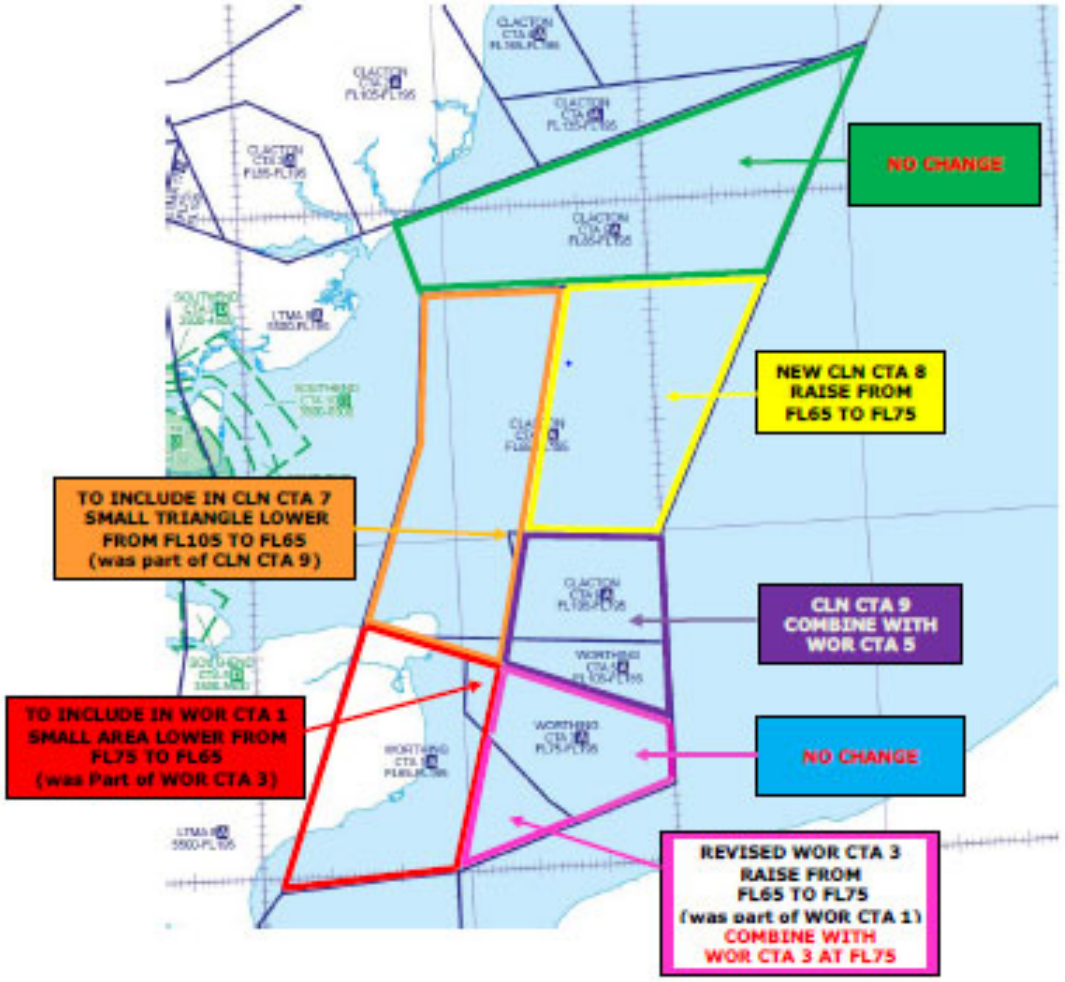
Clacton CTA & Worthing CTA (East) Proposed Base Changes



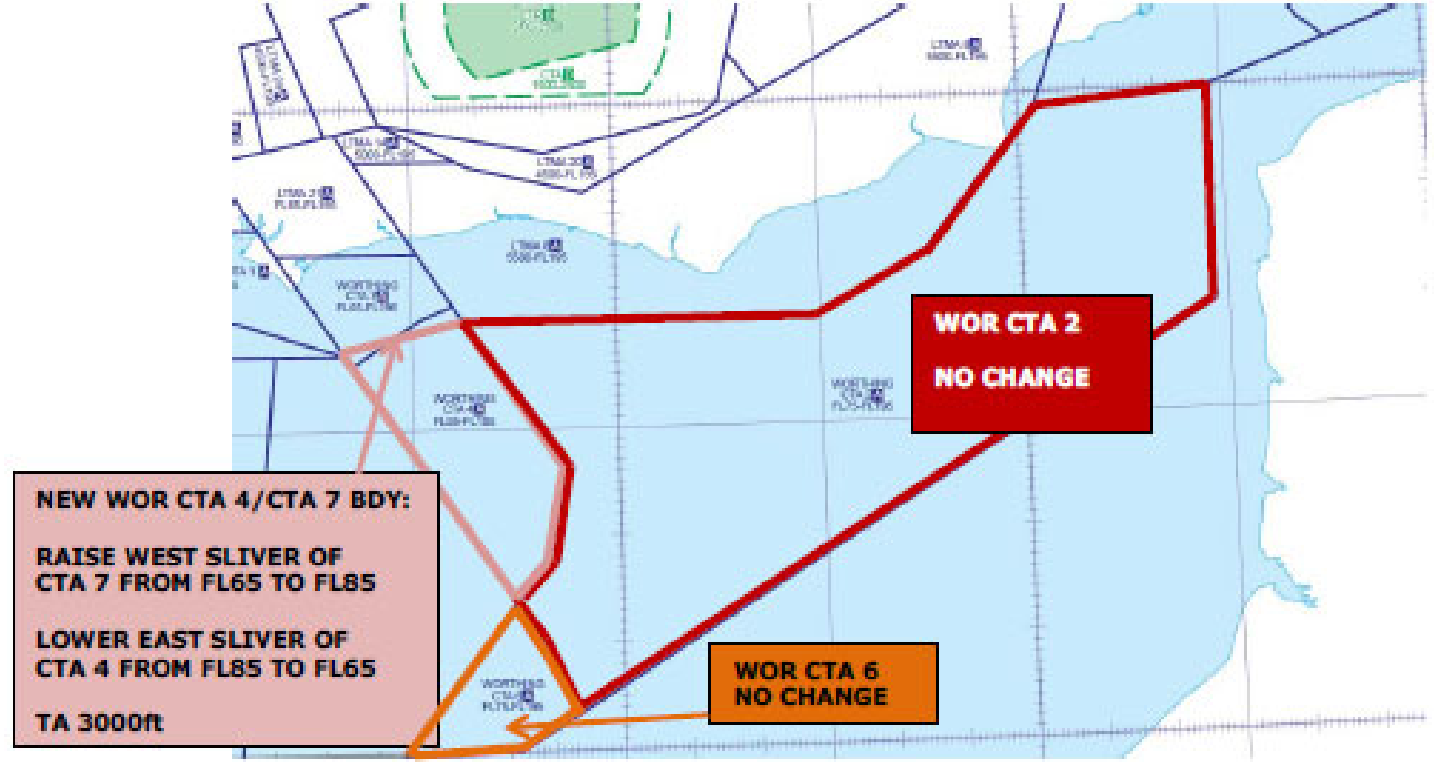
Civil Aviation Authority

Clacton CTA & Worthing CTA (East) Proposed Base Changes

Possible Revision to NATMAC Proposal as at 27 Oct 16



Worthing CTA (South) Option 2
Possible Revision to NATMAC Proposal



LAMP PHASE 1A – INITIAL PIR – LOWER LIMITS OF CAS REVIEW

- CAA action arising from outcome of NATMAC feedback:
- Confirm any outstanding NATMAC feedback due in today
- Any further queries, objection, or support?
  - Seek Group Director SARG approval, then ratify with NATS
  - Confirm AIP amendments can be processed in time
  - Prepare AIC
  - Seek ICAO agreement
- If any show stoppers, then proposals delayed 1 year or withdrawn